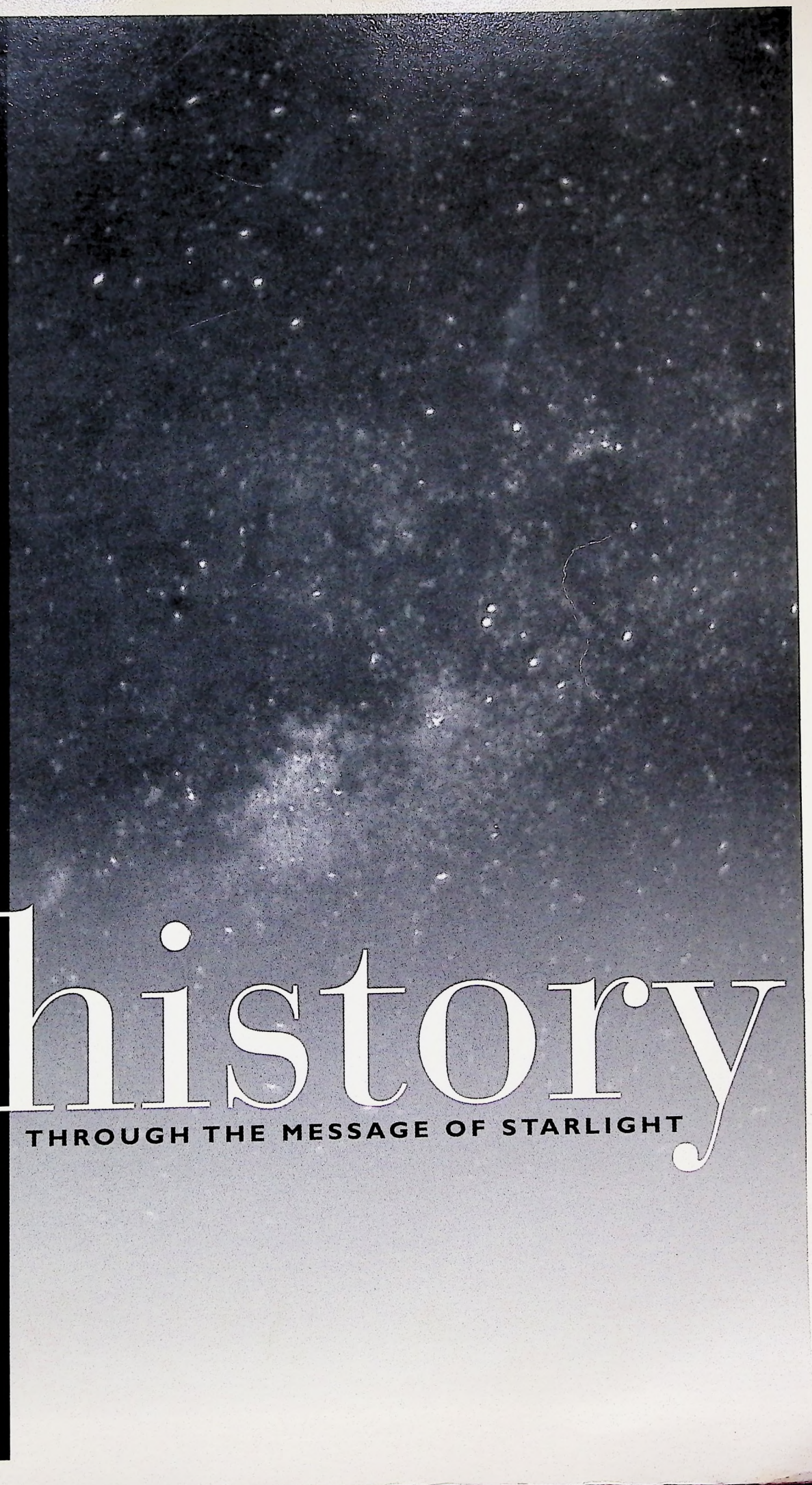

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THROUGH THE MESSAGE OF STARLIGHT

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Dear Neighbor:

For 200 years, Clevelanders have been gazing into the night sky to dream about the future of our city. The legacies of their unique contributions flourish in the technological, artistic, architectural, environmental and community achievements we enjoy today.

The next time you look up into the starlight sky, envision it as a "picture book" of our shared history. Each flickering light you see comes from a star that gave off that light many years ago. Some starlight is so old that we are actually seeing back millions of years in time.

"Cleveland's History Through the Message of Starlight" will teach you how to locate stars that correspond to historic moments in Cleveland's past. We hope to provide you and your family with a creative way to watch the 200 year-old story of Cleveland unfold.

What is it about the stars that frees us to see new possibilities for our world? The world gets smaller with every generation, but its challenges sure seem larger. Stars--enormous, radiant masses of energy--seem to inspire us to meet those challenges. When we let our minds explore on a starry night, some of us catch a glimpse of solutions.

We are excited about the naming of an asteroid "Cleveland" in honor of our Bicentennial year. When students, astronomers and researchers review the names of these asteroids that circle the sun, they will be reminded of the great city and people for which the asteroid was named.

The Bicentennial Commission wishes to thank each of the contributors responsible for the development of this publication. Through their effort, we can gaze skyward to envision Cleveland's rich past and our own dreams for its future.

Enjoy the night sky.

Sincerely,

Jerry Sue Thornton

Dr. Jerry Sue Thornton
Education Co-Chair

+ Anthony M. Pilla

Bishop Anthony Pilla
Education Co-Chair

cleveland's history

THROUGH THE MESSAGE OF STARLIGHT

by Dr. R. Lynn Bondurant and Cynthia A. Hill

Produced for the **Cleveland Bicentennial Commission**
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Time Travels by Starlight

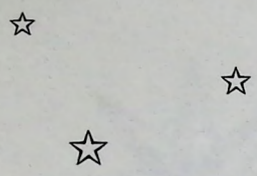
One of the most astounding events of this bicentennial year is about to take place in your own backyard! Hurry. It's getting dark now. Gather up the kids, the neighbors or that active youth group of yours. Then run outside – to your yard, the porch or the park down the street. Ready yourselves for the experience of a lifetime. You'll have to grow very still and sharply observant.

Now . . . look up into the night sky. You're about to see something that has never been seen before this moment. Watch and you'll see Cleveland's life story arrive on a beam of light.

Mystified? How can the past and present meet so close to home? Not through memory this time around. Rather, the past is constantly traveling to the present through starlight! Our night sky is a museum of historic star treasures, each sparkling with light from a time long past. Particles of light leave each star and travel through millions of miles of space, taking years to reach the Earth. This means that the starlight arriving in our hometown tonight has *never been seen* by anyone before now!

Clevelanders from every era have dreamt under these amazing stars. Their dreams have spoken to the needs of their lives in special times in history. Though we have lived different lives within many eras, we've all shared the same night sky and the wonder it evokes in us. Stars create corridors of light that bridge the centuries.

So what happens as you gaze up into this night sky, flickering with light? Do you search out that old "wishing star"? Does a childhood dream begin to whisper? Is an answer out there, just waiting for you to catch a glimpse of it? Or do stars move you to reflect on what has gone before?



"[Thursday, July 21]. . . fixed the quadrant for an observation of the sun at noon. The day was fair and their observation was good. In the evening we again took the variation by the star, and Mr. Pease observed several of the stars for the latitude. After comparing observations they make the latitude to be forty-one degrees twenty seconds north . . . Saturday afternoon [July 23] Mr. Porter went down to the corner, and set a chestnut post, sixteen inches by twelve, on the south side is latitude forty-one degrees north, variation one minute twenty-one seconds east, west side is south-east corner New Connecticut.
– July 23d, 1796, on north side, sixty-eight miles Lake Erie; east side, Pennsylvania."

— Journal entry from Cleveland's first surveying party

However you spend quiet time under the stars, we invite you to view the night sky as you have never done before. *Cleveland's History Through the Message of Starlight* will share the life story of our city through a unique approach in stargazing.

Time traveling at the speed of light

We see the flash of lightning before we hear thunder because light travels faster than sound. Light travels at 186,000 miles/second (299,792,458 km/sec).

The time starlight takes to reach us depends on the distance of each star from Earth. For example, sunlight takes only about eight minutes to reach us, even though the Sun is 93 million miles (149,597,870 km) away from the Earth. In one year's time, light travels nearly 6 trillion miles (9.46 x 10 km), a distance which astronomers call **one light year.**

This means that light from a star 100 light years away from Earth left its star in 1896 to reach us in 1996. Can you imagine for a moment the lessons that were learned from the events in 1896? Imagine those lessons traveling along that beam of light like a voice over a telephone wire . . .

A call from the past

This book will pinpoint stars and identify Cleveland events that occurred just as light first left those stars. Unique monthly star charts have been designed with a custom view of our Cleveland night sky to help you find those messages. Opposite each chart is a list of easily visible stars that are between eight and 200 light years away. Each star is paired with historical events and people instrumental in shaping our city. Stare into that old light, ponder these historic moments and listen for messages from our past.

It's amazing how starry skies can slow us down to think. **Ponder Points**, a description of Cleveland life, have been developed to draw you into our city's story. The questions that follow each point will challenge you to reflect on past, present and future life in our city.

The custom star charts present the Cleveland night sky as seen from the East 9th Street Pier. Your perspective will be similar wherever you live.

Because the stars were selected for highest visibility, pivotal events were paired as closely as possible with them. Some events will send you back a few years or give you a sneak peek into the future as you gaze at the stars.

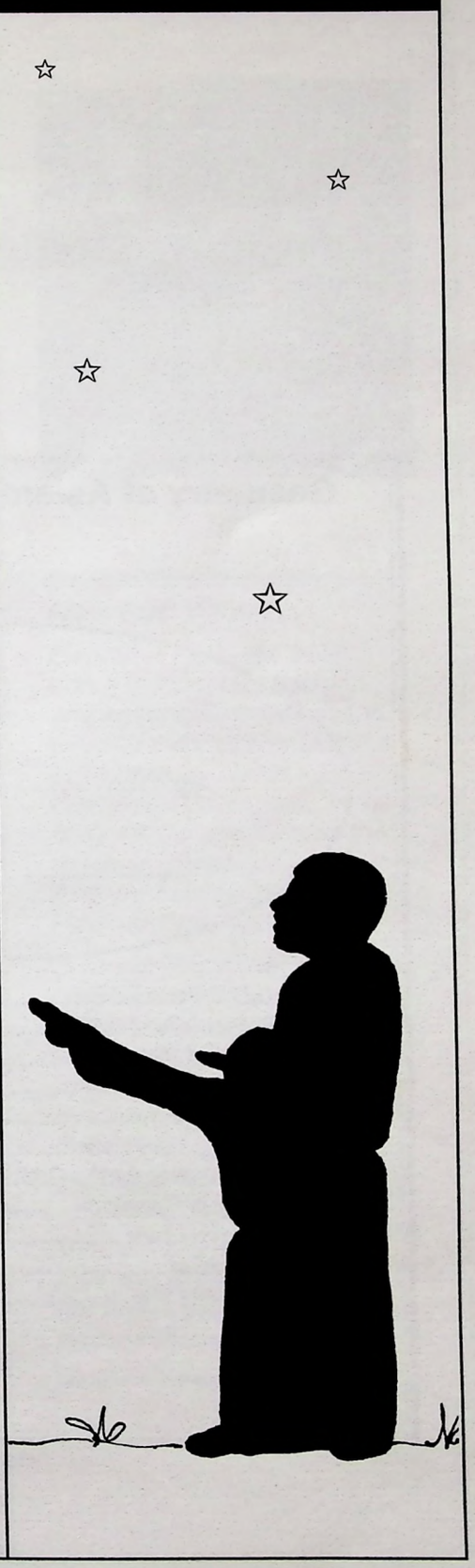
Navigating Cleveland skies

Don't know how to locate stars? It's easier than you think. Different levels are stargazing activities are presented in this book. The first level, **Reach for the Stars**, offers simple activities to get you out under the stars quickly. For the more adventurous time traveler, basic stargazing techniques and terms are introduced in the section, **Stargazing in 5 Easy Lessons**. The first surveying party, under the leadership of General Moses Cleaveland and chief astronomer and surveyor Seth Pease, used these techniques to plot our city's coordinates in 1796. An easy-to-use checklist, called **Eyes to the Skies**, is also provided.

For Aspiring Astronomers provides detailed information on each star for close encounters of the third level! Astronomical facts – such as sunset and sunrise times, astronomical twilight, and times for the rising, setting and phases of the Moon – are also provided. Special sky events are cited as well, such as lunar eclipses and the Quantrantids meteor showers.

Whichever approach you use to ponder the stars, by the end of the year you will have identified over 180 stars and 550 events in Cleveland history. But don't stop there! Find out the year your street, school, or place of worship was established, and locate the star that shines with that year's light. Read more about our rich heritage at your local library.

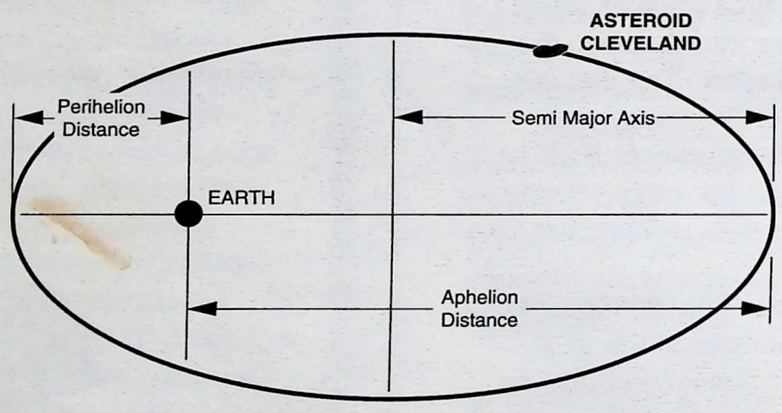
Above all, enjoy the night sky. *Pleasant dreams . . .*



Cleveland's birthday present, an asteroid named 'Cleveland'

On July 12, 1988, Dr. Eleanor Helin, a NASA planetary astronomer with the Jet Propulsion Laboratory, discovered a new asteroid from her observations through the 18-inch Schmidt telescope at Palomar Observatory in California. The asteroid was the 6,296th asteroid discovered up to that time. Now, in honor of our bicentennial, Dr. Helin has named her 1988 discovery **Cleveland**.

Geometry of Asteroid Cleveland's Orbit



Orbital Period	2.60 Yrs.
Eccentricity of Orbit	0.0617238
Aphelion Distance	2.007719 a.u.*
Perihelion Distance	0.88328 a.u.*
Semi Major Axis	1.891 a.u.*
Average Daily Motion	0.37901418°
Inclination to Earth's Orbit (Ecliptic)	27.05318°
Absolute Magnitude	13.6
Discovery Date	July 12, 1988
Discoverer	Eleanor F. Helin
Discovery Site	Palomar Observatory

*astronomical units

Discoverers of asteroids have the honor of naming their discovery(ies), given the approval of the International Astronomical Union. Names of asteroids vary. Some of the names of asteroids include Ceres, Pallas, Juno, Eos, Russia, Elvira, Harvard and Arizona.

Helin is a world-renowned astronomer, known especially for her studies of asteroids. In 1976, she discovered the first asteroid whose orbit lies mostly inside the orbit of Earth. Helin named this asteroid "Aten." Aten became the prototype asteroid for a class of asteroids that have orbits smaller than the Earth.

Our solar system is known for its nine planets with their 65 known moons, the Sun and comets. Less known, but very important, are the asteroids. Most asteroids orbit the Sun between Mars and Jupiter in a "belt" that consists of billions of rock fragments, ranging in size from small grains to the large asteroids. Ceres is the largest asteroid, over 600 miles (960 km) in diameter.

About Asteroid Cleveland

Cleveland is an inner belt asteroid. It has a highly inclined (or tilted) orbit. Cleveland's inclination is 27°. It is a member of the Hungaria class of asteroids, all of which have highly inclined orbits. Hungaria asteroids may be perturbed (or drawn) into Earth-crossing orbits. Cleveland is a moderately sized asteroid, about 3 miles (5 km) in diameter.

Asteroid Cleveland is relatively bright as asteroids go, but do not expect to easily spot it in the night sky. You will need a large telescope and exact locations to find it. The apparent brightness (or *magnitude*) of an asteroid depends on its size and its distance from Earth. Astronomers use the absolute magnitude of asteroids to compare them. Cleveland has an absolute magnitude of 13.6. For asteroids, **absolute magnitude** is defined as the magnitude the asteroid would have if it were one astronomical unit from the Earth, when the Earth is one astronomical unit from the Sun and the asteroid is fully illuminated. **One astronomical unit** is the distance that the Earth is from the Sun, 93 million miles or 1.495×10^8 km.

As 1996 begins, Cleveland will be in the daytime sky and therefore not visible. During its last opposition on January 2, 1995, Cleveland was in the constellation Gemini. At that time, it was favorably placed for us to see it with a large telescope. Its next opposition occurs near the end of August/beginning of September 1996. Unfortunately, for this opposition, Cleveland will be very low in the southern sky (declination -45° 13 minutes; see explanation of declination in *5 Easy Steps*). It will be too low for us to see. The next favorable opposition for us to see Cleveland is April 1998. At this time, Cleveland's right ascension will be 15 hours 3 minutes and its declination +38° 41 minutes. Its visual magnitude will be 16.2 and it will be 1.036 AU (or 96.3 million miles) from Earth, in the constellation Bootes.

Asteroid Cleveland moves on an average 0.4° each day. At this speed, it takes Cleveland 2.6 Earth years to complete one orbit about the Sun.

Dr. Helin

About Dr. Helin . . .

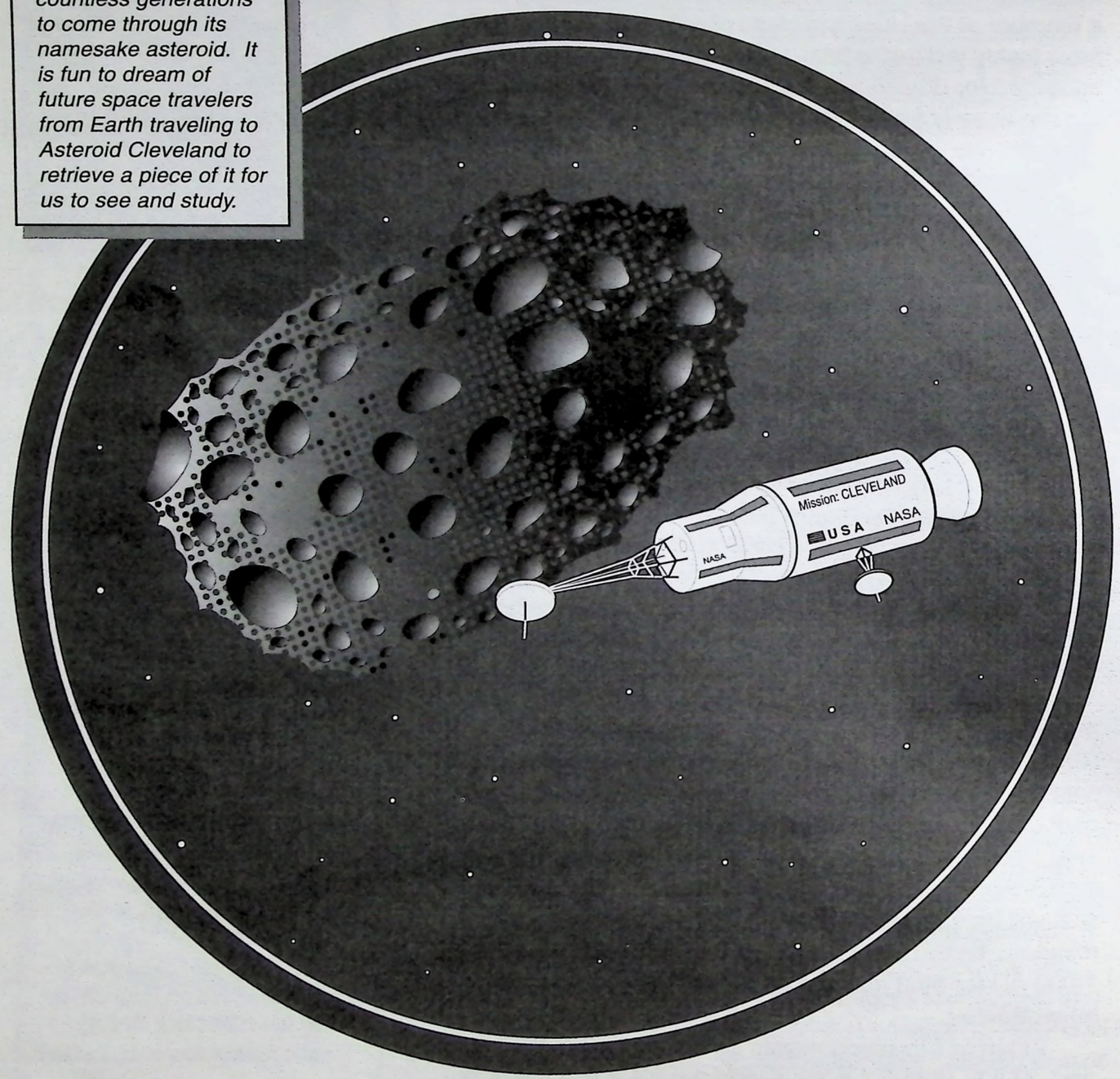
Eleanor F. Helin has been active in Planetary Science and Astronomy for almost 35 years at the California Institute of Technology and the Jet Propulsion Laboratory. In the early 1970s, she initiated the Palomar Planet-Crossing Asteroid Survey (PCAS) from Palomar Observatory.

In recognition of her accomplishments, NASA awarded Dr. Helin the Exceptional Service Medal in 1986. In addition, Asteroid (3267) Glo was named for her by the International Astronomical Union.

Helin was selected as "Woman of Science" in 1982 by the YWCA. She has been awarded research grants by the World Space Foundation and the Planetary Society.

Thanks to Dr. Helin, the City of Cleveland will be remembered for countless generations to come through its namesake asteroid. It is fun to dream of future space travelers from Earth traveling to Asteroid Cleveland to retrieve a piece of it for us to see and study.

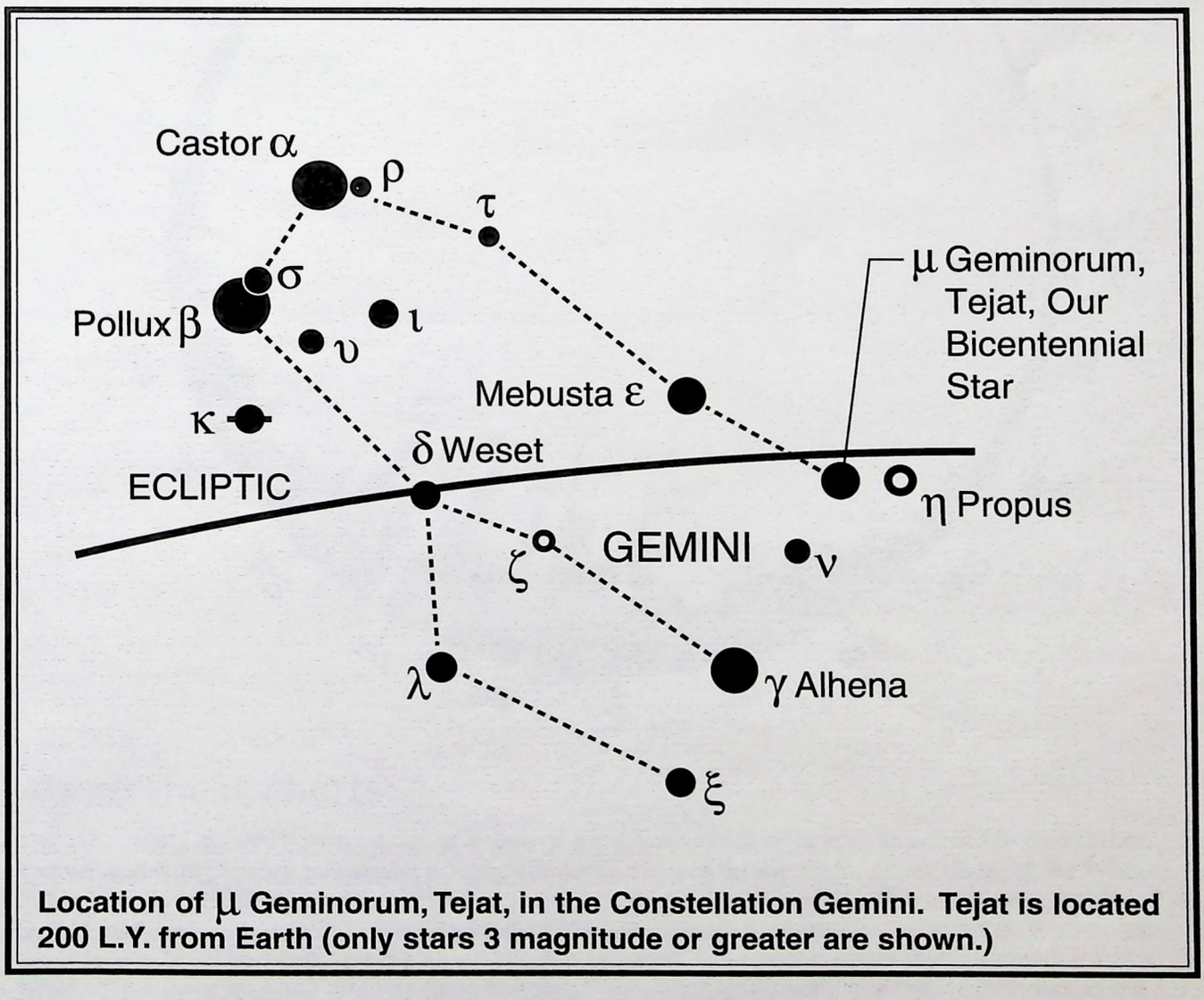
Imagine . . .



. . . a future astronaut crew traveling to Asteroid Cleveland to retrieve a piece of it to return to Earth to display in Cleveland as part of the city's 250th birthday celebration.

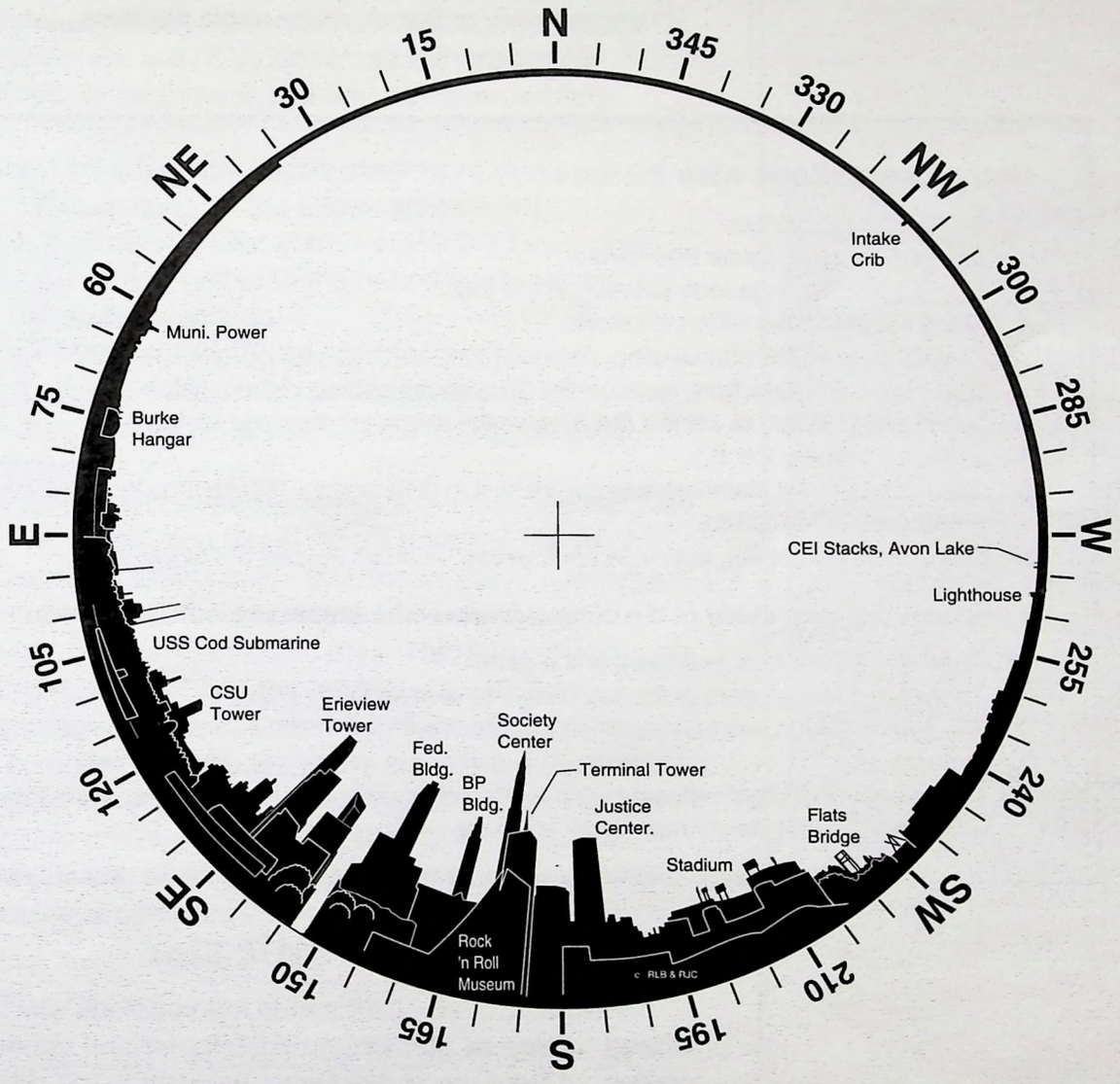
Cleveland bicentennial star chosen

Cleveland's bicentennial star is called **Tejat**, meaning unknown. It is located in the constellation of Gemini, 200 light years away. The light from this star was used to usher in our bicentennial year in Cleveland. The light left Tejat on its journey toward Earth the same year Moses Cleaveland and his survey party first arrived at the mouth of the Cuyahoga River (July 22, 1796).



Location of μ Geminorum, Tejat, in the Constellation Gemini. Tejat is located 200 L.Y. from Earth (only stars 3 magnitude or greater are shown.)

Reach for the Stars!



About these charts:

The star charts for this booklet present a view of the Cleveland skyline from the East 9th Street Pier. The skyline was photographed with a tripod-mounted camera on the stern, upper deck, of the William G.S. Mather. Generous overlap of buildings and landmarks was provided. The prints were cut together, traced, reduced and scanned. The scanned image was used in a computer, using an illustration program to create an accurate line drawing. Another program was used to curve the line drawing into a circle. Panorama features and compass headings were aligned to each other using information the artist gleaned from city planners, county employees, air charts and a multitude of maps. The star charts are courtesy of Mt. Wilson Observatory.

Sharpening your sky-watching skills

Study the night sky and write down 10 observations that you, your family or friends make about the stars.

Star observations may include:

- ☆ Stars seem to twinkle.
- ☆ Some stars are brighter than others.
- ☆ Some star groupings form patterns in the sky.
- ☆ Stars seem to have different colors.
- ☆ City lights interfere with viewing.
- ☆ Stars seem to move from east to west through the course of the night.
- ☆ Some stars appear to set like the Sun, while others rise from the horizon.
- ☆ Stars are all over the sky.
- ☆ After rising, many stars seem to get highest in their journey across the sky when they are directly in the South.
- ☆ Some stars do not set, but circle another star, such as Polaris, the North Star.

If you continue your study of the stars over several months, you will also notice:

- ☆ Stars rise earlier from one night to the next.
- ☆ There are different stars in the sky from one season to the next.
- ☆ The planets, Moon and Sun are always located near a group of 12 constellations (also known as the zodiac).
- ☆ The amount of daylight varies during the different seasons; the longest nights are in the winter months and the shortest nights are in the summer months.

Twinkle, twinkle little star

Starlight from a given star is not constant; stars do indeed twinkle as starlight grows brighter and dimmer. The amount of twinkling varies from one night to the next and is also influenced by how high the star is above the horizon. Starlight has to pass through the atmosphere over Cleveland to reach your eyes. The atmosphere is not calm, but rather is quite turbulent. The more turbulent, the greater the twinkling we observe.

When a star is close to the horizon, it has to pass through a greater amount of atmosphere. Not only does the twinkling increase, but the star seems to flash different colors.

Star light, star bright . . .

All stars are not the same brightness. A word that astronomers use to describe brightness is **magnitude**. The brighter the star, the lower its assigned magnitude. In this guide, we are only concerned with **apparent magnitude**, or brightness of a star as observed from Earth.

In ancient times, the visible stars were ranked in six classes of magnitude by the Greek astronomer, Hipparchus. The brightest stars were of the first magnitude and those just visible to the naked eye were assigned the sixth magnitude.

In the 19th century, British astronomer Norwan Pogson quantified the scale more precisely so that each step in magnitude equals a difference in brightness of 2.512 times.

A star of the first magnitude is 100 times brighter than a star of the sixth magnitude. You'll notice in the resources section of this guide that some stars have negative magnitudes. This indicates that the star is much brighter than a first magnitude star. The Sun's magnitude, for example, is -26.7 and the full Moon is -12.2.

A good point of reference to note viewing conditions and to compare magnitudes of the stars is the bowl of the Little Dipper in Ursa Minor. The stars in the bowl of the Little Dipper are of the magnitudes 2, 3, 4 and 5. Determining their relative brightness to other stars will give you a good idea of current viewing conditions.

Night colors

It is also observed that stars have different colors. This is especially true of the brighter stars. The color of a star is indicative of its temperature. Red-colored stars are cooler than white stars. Astronomers use an instrument called a **spectroscope** to determine stellar surface temperatures. The spectral types, in order of decreasing stellar surface temperature, are designated O, B, A, F, G, K, and M.

Spectral Types and Surface Temperature Estimations

Type	Color
O	Blue
B	Blue
A	Blue-White
F	White
G	Yellow-White
K	Orange
M	Red

Type	Temp. Range (°F)
O	45,000 - 90,000°
B	19,800 - 45,000°
A	19,800 - 135,000°
F	10,800 - 135,000°
G	9,000 - 10,800°
K	6,300 - 9,000°
M	5,400 - 6,300°

On the lighter side

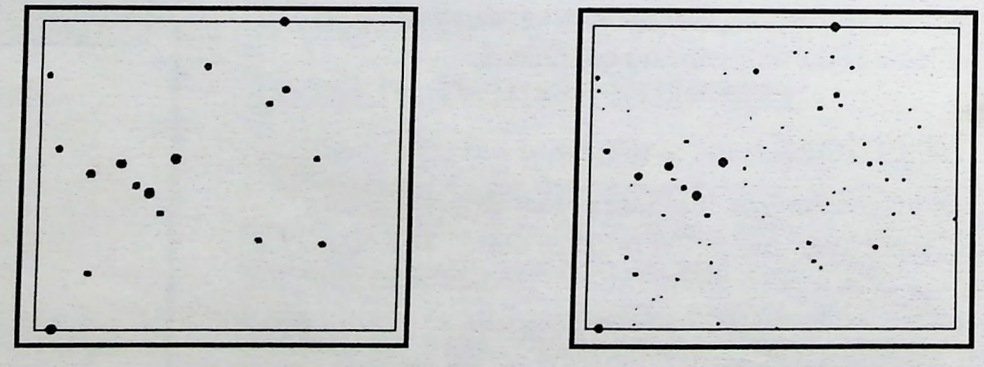
The amount of starlight visible to you will depend on the lighting circumstances in your area. Street lamps on a neighborhood street will diminish the amount, while a dark country road will reveal a sky blazing with starlight.

Our oldest picture book

One glance at the night sky reveals that the stars seem to form recognizable patterns. The ancients of Greece and Rome were entranced by this observation. They formed star groupings called constellations out of these patterns, and named the groupings after gods and characters in the great epic stories of their time. These stories and constellation names have survived thousands of years and still capture our imagination under a starry night. Today, astronomers recognize 88 constellations, some of which are not visible from Cleveland. Some star groups are too far south of our horizon and never rise.

Constellations represent an object in the sky: Orion, a hunter; Canis Major, a dog; Libra, balanced scales;

Area of Sky Near Cassiopeia Under Two Lighting Conditions



A B

Notice that more stars can be observed in the same area of the sky when the sky is darker as shown in "B."

Scorpius, a scorpion; Lyra, a lyre, and so forth. Today, each of the constellations has a **boundary** as well defined as the state boundaries in the Unites States. With a little imagination, constellations can transform the night sky into the world's oldest picture book.

Two groups of constellations are the **circumpolar** constellations and the constellations of the **zodiac**. In Cleveland, as we face north at night, we will always see five easily recognizable constellations above the horizon: Ursa Major, Ursa Minor, Cepheus, Cassiopeia and Draco. They are called circumpolar because their stars are always above the horizon for us, although not necessarily in the same spot in the sky at the same time throughout the year.

In Cleveland, the North Star is approximately 41.5° above the horizon in the north. All stars with a declination greater than 48.5° never set in Cleveland.

What's in a name?

When you read a star chart, you will notice that stars are identified in several ways: by name, by letter of the Greek alphabet or by number assigned to the star. In 1603, a system for naming the stars was introduced by Johann Bayer. In his system, letters of the Greek alphabet were used to name the stars within each of the constellations. Inside most constellations, the letter alpha was given to the brightest star, beta was given to the second brightest, etc. The Greek letter was followed by the Latin name of the constellation, as in Alpha Centaurus.

In 1725, Flamsteed assigned a number to the fainter stars. A name like 28 Tauri refers to a specific star, in this case, Pleione in the Pleiades. Flamsteed numbered the stars in a constellation from its most western point to its most eastern point. The star that is farthest west in a constellation is one, the next most farthest west is two, and so on.

In the Eye of the Beholder

"The Big Dipper"
– North Americans

"The Plough"
– English

"The Celestial Bureaucrat"
– Chinese

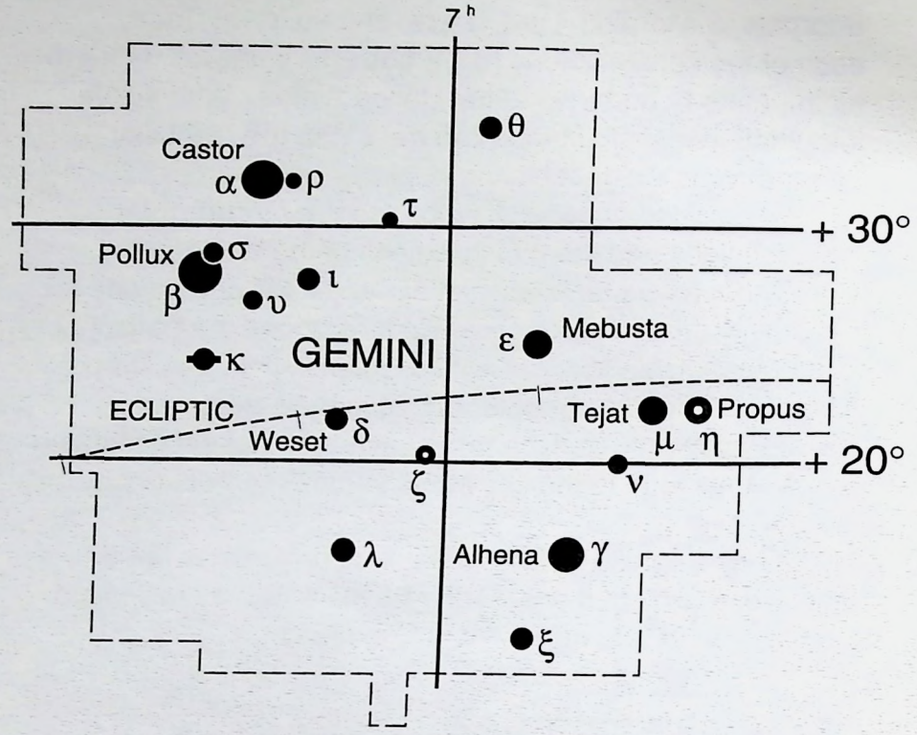
"The Casserole"
– French

"Charles' Wain *(or wagon)*"
– Medieval Europeans

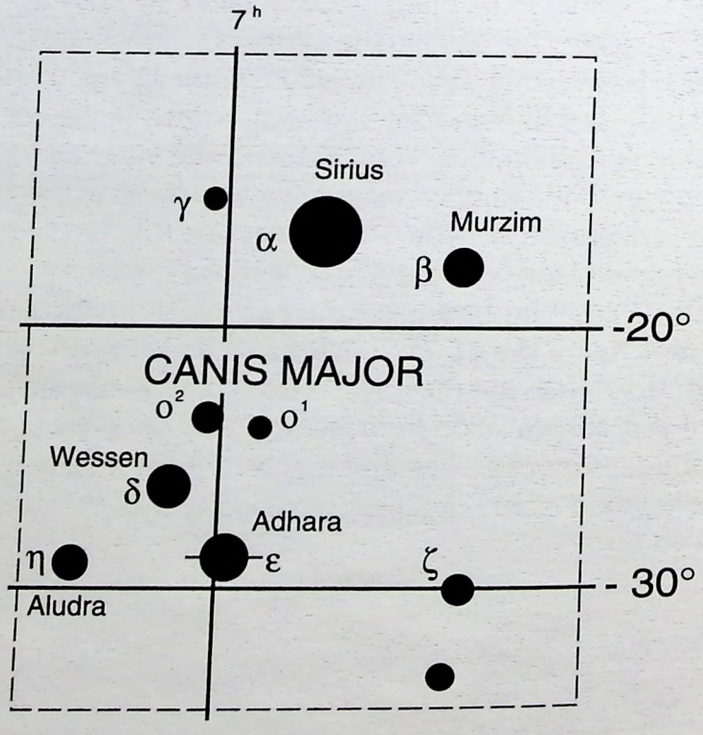
"Tail of the Great Bear"
– Ancient Greeks

"Bull, Man and Hippo with Crocodile on Back"
–Ancient Egyptians

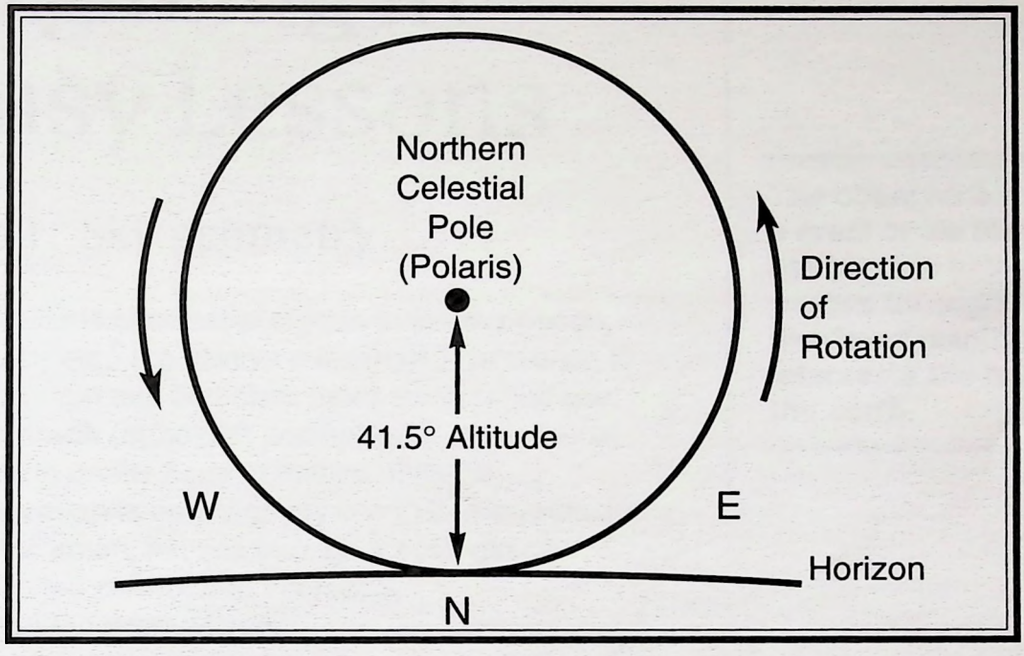
Constellation Boundary for Gemini



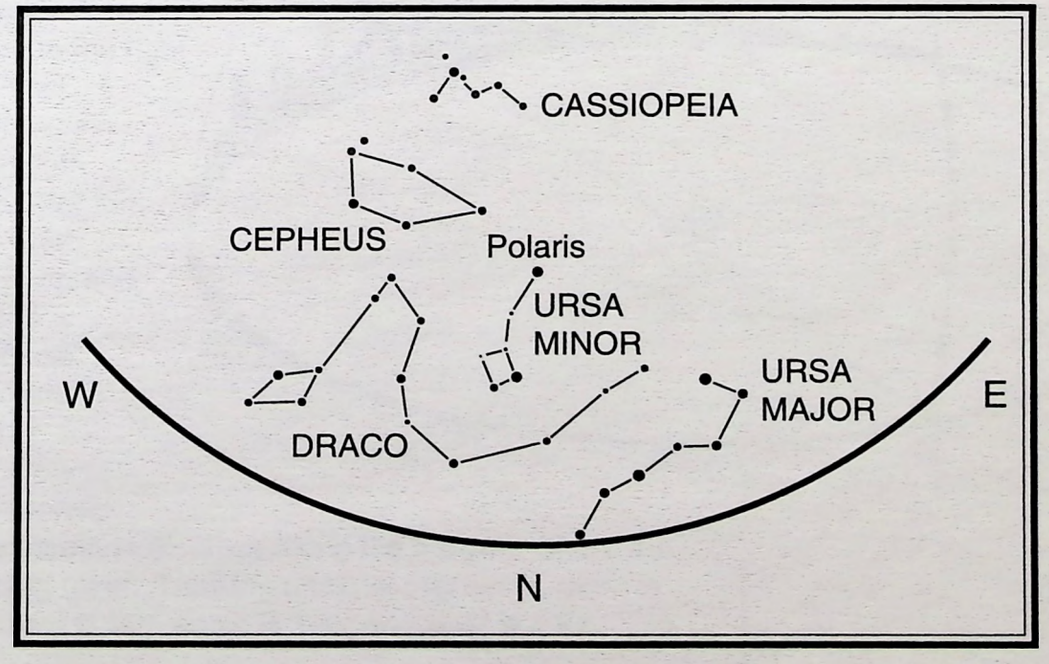
Constellation Boundary for Canis Major



Circumpolar Region in Northern Skies of Cleveland



Locations of Circumpolar Constellations for Jan. 1, 1996, at 8 p.m. EST in Cleveland (facing north)



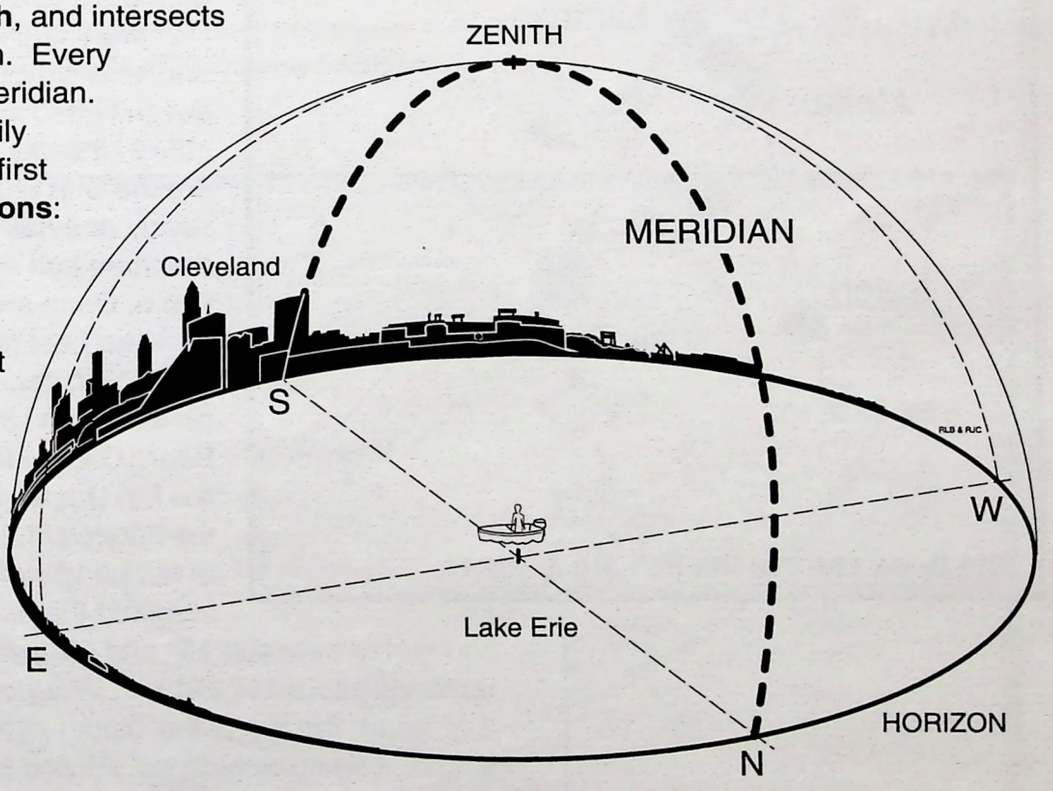
Stargazing in 5 Easy Lessons

Lesson 1: Sky geometry

The observer's meridian is a great circle that intersects the horizon in the south, passes through the point overhead (zenith) and intersects the horizon in the north.

The positions of celestial objects in the sky (moon, stars, planets, etc.) are always measured in reference to your horizon. You can find stars more easily when you know the **altitude** (or height) and **azimuth** (or distance) from due north on the horizon that an object is.

The **meridian** is an imaginary line that intersects the horizon in the south, passes through a point directly overhead, called **zenith**, and intersects the horizon in the north. Every location has its own meridian.



You can more easily locate stars when you first determine your **directions**: north, south, east and west. When you are facing due north, a quarter turn to the right faces you east. A quarter turn again faces you south. Another quarter turn faces you west. Return to north and you've made a complete circle.

That circle is measured in **degrees**. Degrees are units that help navigators measure distance along the horizon, where the sky and earth meet. Thinking again of that circle, north is 0 or 360°, east is 90°, south is 180° and west is 270°.

The azimuth of an object is measured in the degrees it is away from due north. A star's altitude refers to how high a star is above the horizon.

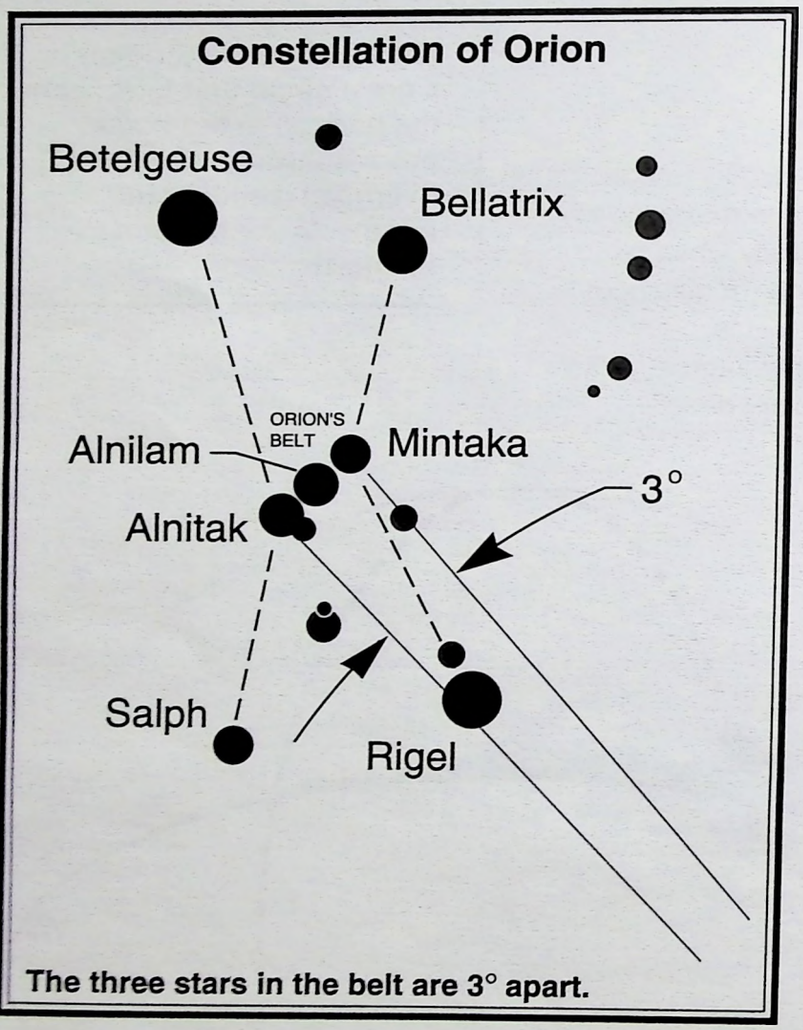
On the horizon, an object's altitude is 0°. When it is directly overhead or at its zenith, its altitude is 90°.

So if you had to find a star with an azimuth of 180° and an altitude of 45°, you would face south (180° from north) and look above the horizon to a spot midway between the horizon (0°) and the zenith (90°), which is straight overhead.

As you look into that blaze of stars overhead, you may ask yourself, "How can I possibly measure degrees and angles in the sky?"

You'll find that determining angles is simple with the use of several good measuring sticks available in the sky. Two familiar objects are the Sun and the Moon; both are nearly one-half degree in size. Also, the three belt stars in the constellation of Orion are 3° apart.

The best reference, however, is the Big Dipper, which is part of the constellation Ursa Major, the Big Bear. On January 1, 1996, at 8 p.m., the Big Dipper will be located near the horizon in the north, with the top of the handle of the Big Dipper nearly touching the horizon. The bowl will be located between 15° and 30° azimuth, extending upwards about 10° altitude. The pointer stars are about 5.5° apart; the top of the Dipper extends about 10° in length. (*See graphics, pp. 21 and 88.*)



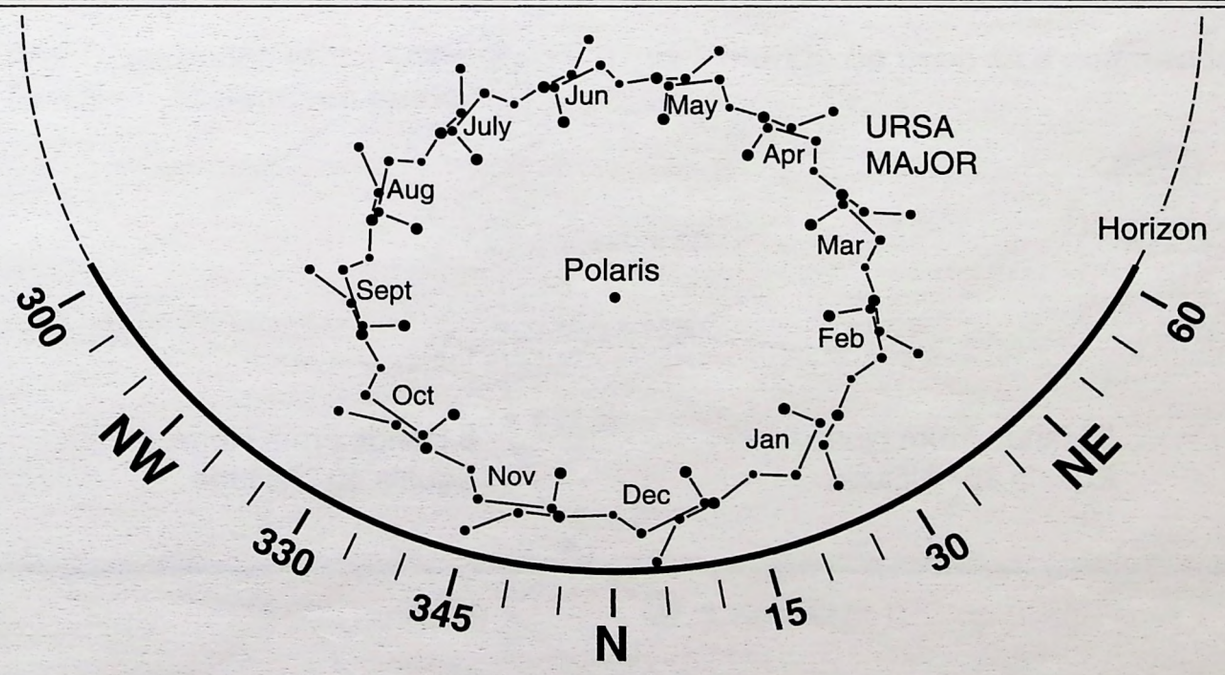
The three stars in the belt are 3° apart.

Lesson 2:
Handmade sextant

Before the advent of electronic and radar navigation, travelers used measuring tools, such as astrolabes and sextants, as well as simple observation techniques to determine location and time during navigation.

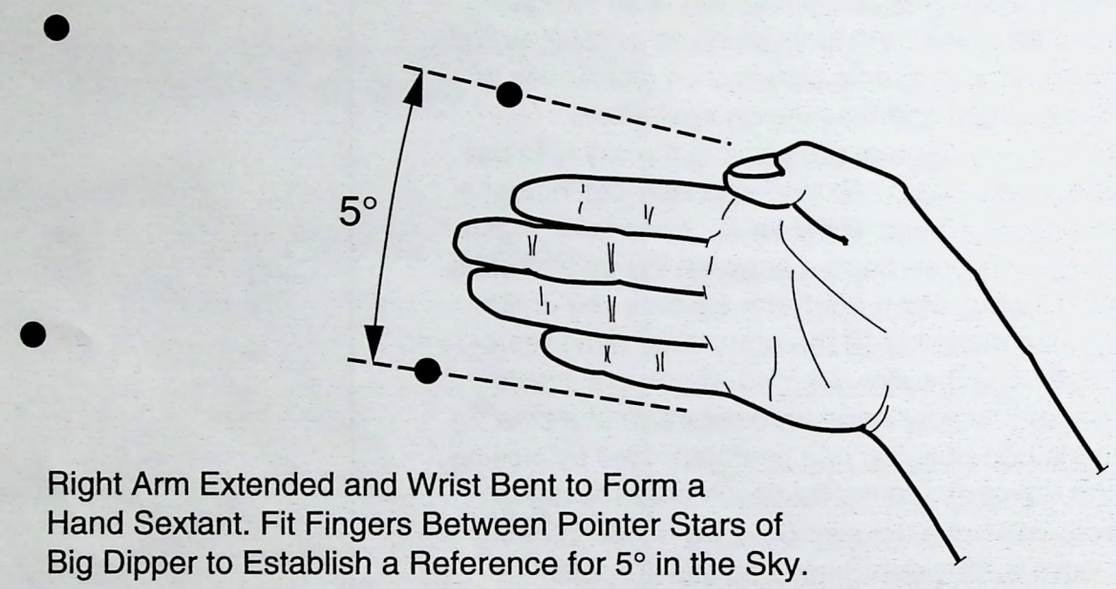
An easy way to measure scale in the sky is to use your hand as a sextant. Extend your arm out in front of you, bending your hand at the wrist. Keep your fingers straight. Then fit your fingers between the pointer stars of the Big Dipper. Move your arm towards you until your fingers completely fill the area. Your hand represents 5° of arc in the sky. As long as you are consistent, you can use your hand to measure 5° at a time.

The altitude of a star can be determined by moving your hand upwards, noting that each time you move this space, you have traveled 5°. Five hands from the horizon equals 25°; eight hands equals 40°, etc.

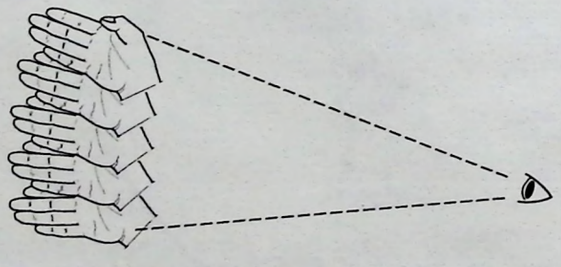


Position of bowl of Big Dipper at 8 p.m. EST throughout the year in reference to the north horizon. (The degrees on horizon relate to azimuth.)

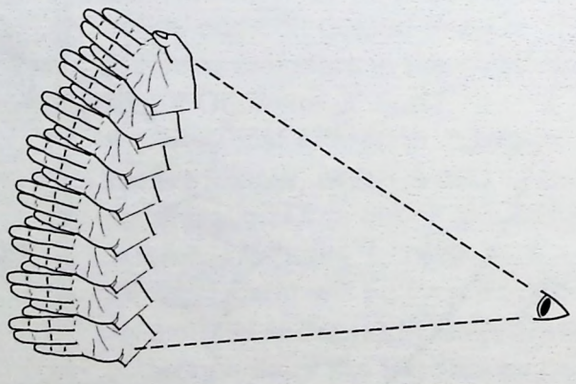
Using a Hand Sextant to measure angles in the sky.



Right Arm Extended and Wrist Bent to Form a Hand Sextant. Fit Fingers Between Pointer Stars of Big Dipper to Establish a Reference for 5° in the Sky.

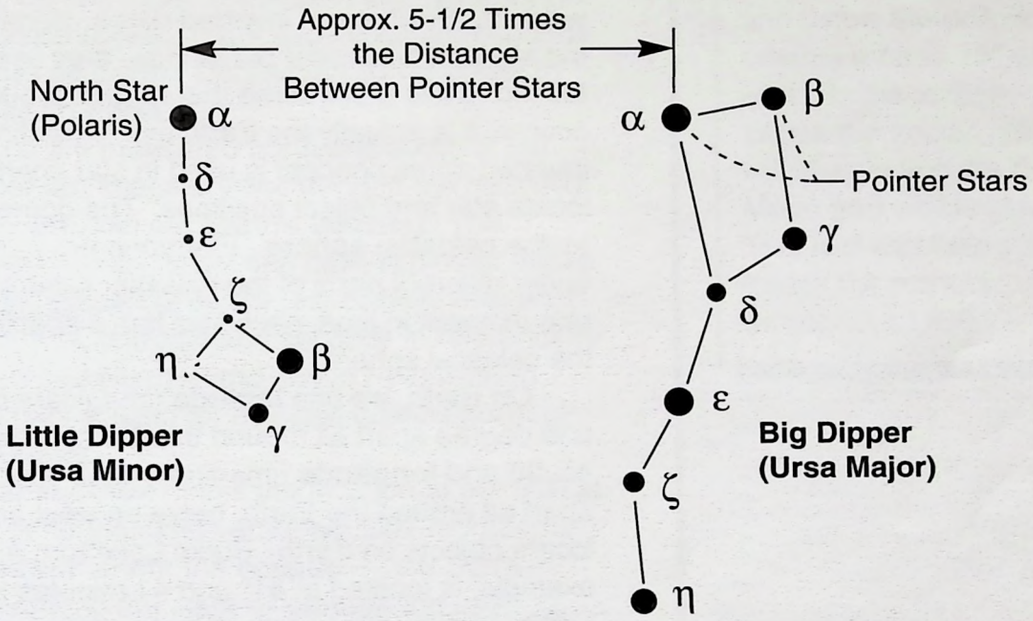


5 Hands From Horizon
Equals 25° Altitude

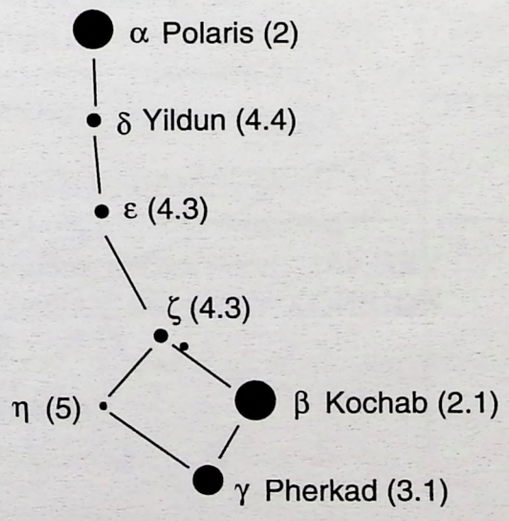


8 Hands From Horizon
Equals 40° Altitude

Using the Big Dipper to help locate the North Star, Polaris, and the Little Dipper. From the pointer stars, approximate a distance about 5-1/2 times the width of the pointer stars to locate the North Star.



Star magnitudes of the Little Dipper (Ursa Minor) to be used as a magnitude (number) comparison guide.

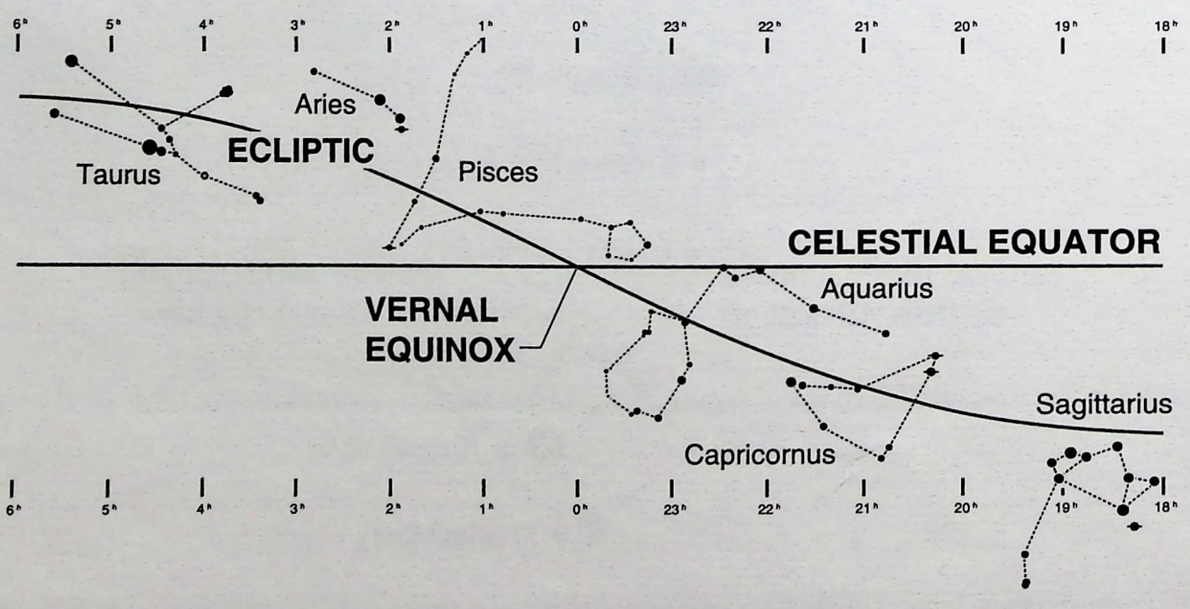


Lesson 3: Mapping out the night sky

When we view the sky, it seems as if we are living within an Earth-sized inverted dome. As stars rise, cross the sky and disappear out of view, they seem to be attached to this great dome that rotates around us. Of course, it is actually the Earth that is rotating. But this inverted dome concept is used in star charts and helps us locate star and object positions. The dome is referred to as the **celestial sphere**. Everyone around the world lives under different parts of the celestial sphere. And at any one moment in time, each star has a specific location on the celestial sphere.

On Earth, we use **latitude** (imaginary lines spaced one degree apart all around the Earth, between north and south) and **longitude** (imaginary lines spaced one degree apart all around the Earth, between west and east) to locate objects on Earth. Burke Lakefront Airport, for example, is located at 81° and 41 minutes west longitude and 41° 31 minutes north latitude, whereas Cleveland

A portion of the zodiac. Note the Vernal Equinox, Ecliptic and Celestial Equator.



Hopkins Airport is located at 81° 51 minutes west longitude and has a latitude location of 41° 24 minutes and 36 seconds.

In the sky, we use **right ascension** and **declination** to locate a celestial object. Right ascension corresponds to longitude lines on Earth. Declination corresponds to the latitude lines on Earth.

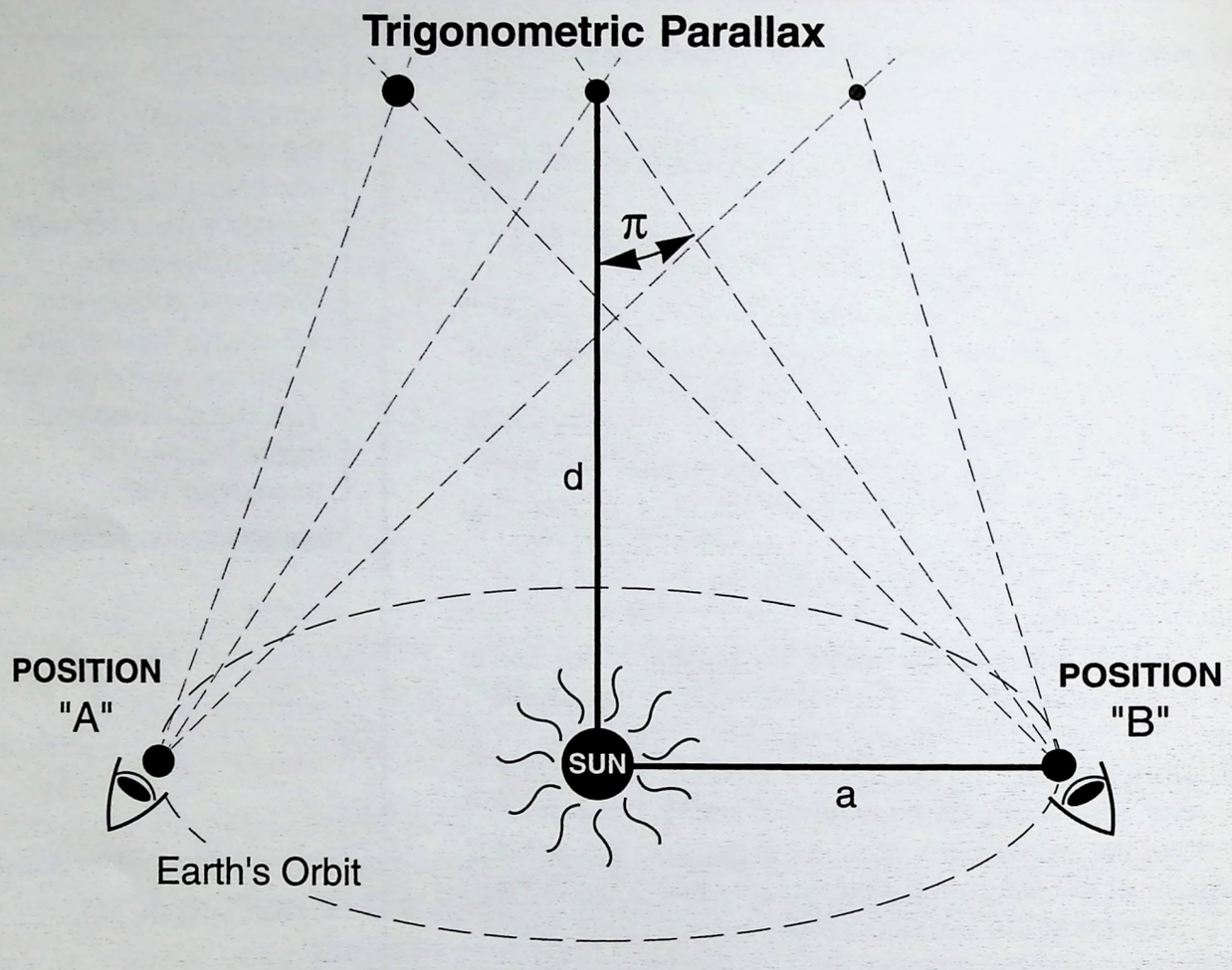
Declinations are measured north and south of the celestial equator (an imaginary line through the middle of the celestial sphere, like our Earth's equator). The maximum declination an object can have is plus or minus 90°, which would place the object respectively over each pole. We use hours, minutes and seconds in reference to right ascension, and plus (+) and minus (-) to refer to declination. A plus is used for celestial objects north of the celestial equator.

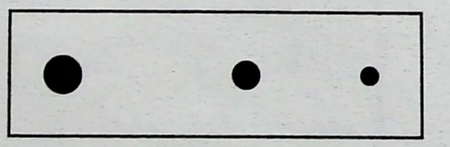
The **vernal equinox** marks the location of our Sun at the beginning of spring. The vernal equinox represents that point in the sky where the **ecliptic** — the Sun's apparent path among the stars — crosses the celestial equator. Following the beginning of spring, the Sun is north of the celestial equator. It will return to the celestial equator at the **autumnal equinox**, the beginning of fall.

Starting at the vernal equinox, every 15° one moves eastward along the celestial equator represents one hour of right ascension. Therefore, a star with a right ascension of three hours is located 45° east of the vernal equinox. Likewise, a star with a right ascension of 14 hours is 210° east of the vernal equinox. There are 24 hours of right ascension. The 24th hour can also be cited as "0 hour."

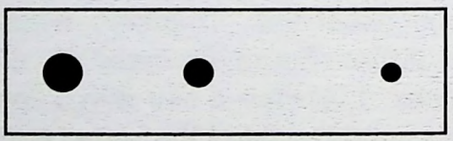
It should be noted that when an object's declination is the same as one's latitude, those objects that cross the meridian at the zenith point. Therefore, in Cleveland, stars with a declination of 41° 31 minutes will pass through the zenith.

Our own Sun's path across the sky is called the ecliptic. -8° above and below the ecliptic creates a band 16° wide, which is the zodiac. Within the zodiac, you will always find the Sun, Moon and visible planets. This fact can help you locate the planets throughout 1996.





Photograph from A



Photograph from B

TRIGONOMETRIC PARALLAX- A process used by astronomers to determine the distance to a nearby star by noting the shift in the star's location in reference to the background of stars as measured from two opposite points in Earth's orbit.

d = distance to star in light years

a = distance of earth from sun (1 astronomical unit equals 93,000,000 miles)

π = parallax

Lesson 4:
Determining stellar distance

As the Earth orbits the Sun, the same stars can be observed from opposite points in our orbit. When photographs are made of the stars, it can be noted that stars shift slightly in their position. Try this activity to help explain this shift:

- ☆ Hold your index finger six inches from the front of your nose. Look at your finger with your left eye closed. Now open your left eye and close your right eye. Look at your finger and see how it appears to have changed position. Your right and left eyes represent opposite points in the Earth's orbit.
- ☆ Now move your finger farther away. Open and close alternating eyes again. Notice this time that the shift does not appear as great. The closer stars are to the Earth the greater their shift in the sky from opposite points in the Earth's orbit. It has been determined that when a star shifts position in the sky by one second of arc, the star is 3.26 light years from Earth.

Distances to nearby stars can be determined by noting the shift in the star's position as measured against the background of stars.

The stellar distances cited in this guide are taken from the *General Catalogue of Trigonometric Parallaxes (1991), A Preliminary Version*, William F. Van Altenna, John Trueh-liang Lee and E. Dorrit Hoffleit, Yale Observatory, New Haven, Conn.

For serious stargazers

The annual parallax can be determined from the shift. In the diagram on the facing page, "a" refers to the distance from the Earth to the sun, π (pi) is the parallax angle. From trigonometry, "d" – the distance to the star – can be determined by dividing the Earth-Sun distance by the angle of the parallax. One second of arc equals a distance of 3.26 light years. Stated differently, the star is 206,265 times farther from the Sun than the Earth is.

"We had the sky, up there, all speckled with stars, and we used to lay on our backs and look up at them, and discuss about whether they was made, or only just happened."

– Huckleberry Finn (by Mark Twain)

Lesson 5: Finding stars, keepers of dreams

In sky watching, we use two kinds of time: **sidereal time**, or star time, and **solar time**, measured by clocks to coordinate the activities of our 24-hour day.

Solar time is based upon the motion of the Sun. One solar day is the length of time it takes for the Sun to cross the meridian in the south (noon) and arrive at that point again the next day. Each solar day is divided into 24 hours with a.m. (*ante meridian*) to designate morning hours from midnight to noon, and p.m. (*post meridian*) to designate afternoon and evening hours, noon to midnight.

Time zones were created to assist in time keeping. Cleveland is located in the **Eastern Standard Time Zone**. The meridian that determines the time for this zone is located near Phildelphia. We are located six degrees west of that meridian. This means that local noon, according to the sun, actually occurs later for us in Cleveland than according to the clocks.

This is because it takes the Earth four minutes to rotate one degree. Therefore, it takes 24 minutes for the Earth to rotate six degrees to bring the sun to directly overhead in the south in Cleveland. The actual time difference is 27 minutes.

The times cited in this guide are Eastern Standard Time. During the times of the year when we are on daylight savings, **one hour must be added to the times cited.**

Sidereal time is based on the motion of the Earth with reference to the stars. One sidereal day is based on the amount of time required for a star to cross the meridian and return to the meridian.

Each star has a specific location on the celestial sphere. What right ascension is on the meridian in the south at any given time determines sidereal time.

As the Earth orbits the Sun, the Sun seems to shift one degree eastward in the sky from one day to the next. This eastward shift means that the earth must rotate an additional degree, or four minutes of time, to bring the Sun

back on the meridian in the south from one day to the next. Therefore, a sidereal day is shorter than a solar day. In fact, a sidereal day equals 23 hours 56 minutes and 4 seconds of solar time.

This means that from one night to the next, a given star rises four minutes earlier in reference to solar time. After a week, the same star rises a half hour earlier than solar, or clock, time. By month's end, it rises two hours earlier. Thus, a star rising at 10 p.m. at the first of the month will be rising at 8 p.m. at the end of the month.

Remember that the right ascension of a star on the meridian in the south at any given time determines sidereal time. One can use the right ascension of a star in reference to the sidereal time to determine where a star is located in reference to the meridian.

The time since the last meridianal transit of a star can be determined by taking the sidereal time and subtracting the right ascension from that number. Likewise, taking the right ascension of a star and subtracting the sidereal time from it will give the amount of time in hours until the star's next meridianal transit.

How to find stars:

Rigel in the constellation of Orion has a right ascension of 5 hours and 14 minutes. **At 8 p.m. on January 1**, the sidereal time is 2 hours and 17 minutes. Subtract the sidereal time from the right ascension.

```
   5 hrs. 14 min.
-  2 hrs. 17 min.
-------------------
   2 hrs. 47 min.
```

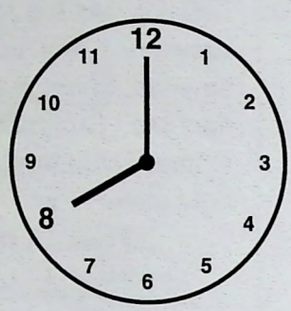
Therefore Rigel will be directly in the South of Cleveland at 10:47 p.m. EST on January 1.

Arcturus is the brightest star in the constellation of Bootes. Arcturus has a right ascension of 14 hours and 15 minutes. In this case, we're going to subtract the right ascension from the sidereal time of 26 hours and 17 minutes.

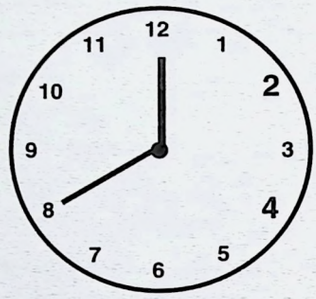
```
   26 hrs.  17 min.
-  14 hrs.  15 min.
--------------------
   12 hrs.   2 min.
```

Arcturus crossed the meridian 12 hours and 1 minute earlier. Therefore it was in the south at 7:58 a.m. It is now situated below the horizon.

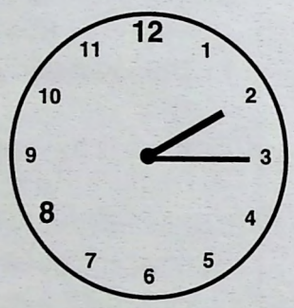
Civil and Sidereal times for Cleveland on two dates in January 1996



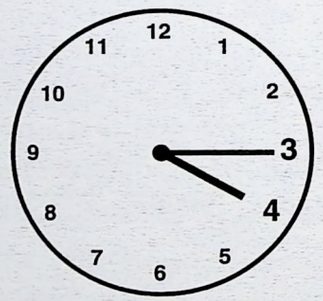
8 p.m. EST Civil Time



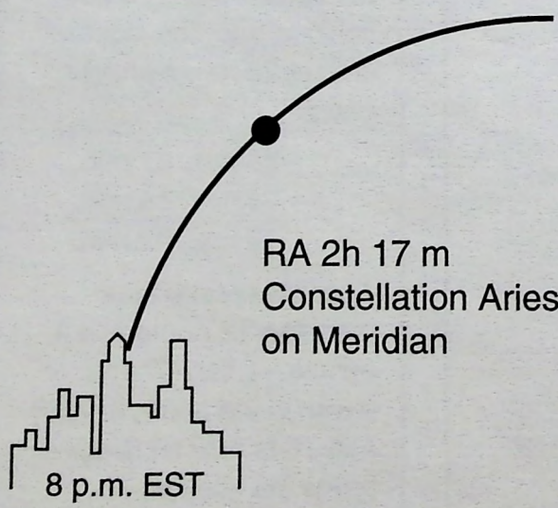
8 p.m. EST Civil Time



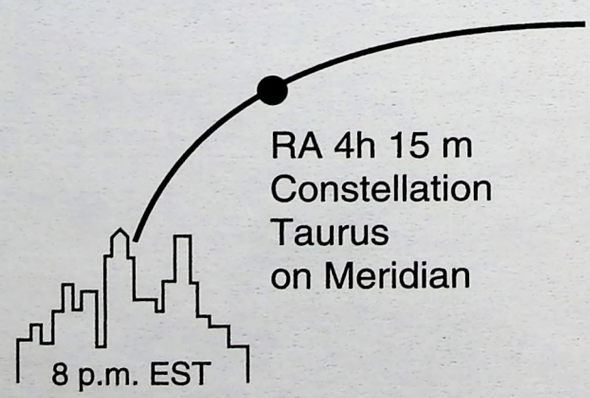
2:17 Sidereal Time



4:15 Sidereal Time



January 1,1996



January 31,1996

The Moon

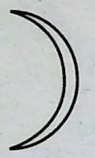
Our nearest neighbor in space

As you spend some time viewing the sky, you might pay special attention to the Moon. It was no doubt beyond Moses Cleaveland's wildest dreams that his city would become so instrumental in developing humankind's knowledge about the Moon, through heroic space initiatives and intensive research at NASA's Lewis Research Center.

Make observations of the Moon and you will find:

- When the Moon is above the horizon at night, it can wash out some of the fainter stars. Compare the sky with the Moon in its first and last quarters to illustrate this.
- The best sky viewing nights are when the Moon is in a new, waxing or waning phase.
- It takes 29-1/2 days for the Moon to go through all its phases.
- The different phases will be seen at different times in a day.
- The Moon appears to look bigger at the horizon as it rises or sets. This is an optical illusion.
- Note the special lunar events listed in the star charts, such as the lunar eclipses in April and September.
- The Moon moves about 26 full moons placed side by side to the east from one day to the next. This results in the Moon rising almost 52 minutes later, according to the clocks, each day.
- It takes the Moon about two minutes to move its own diameter to the west.

Phases of the Moon With Observation Notes

Phase	Description/ Location in Sky
 Waxing Crescent	Appears in western sky at evening twilight and sets sometime between sunset and midnight.
First Quarter	Appears almost due south at sunset and then moves through the western sky, setting about midnight.
Waxing Gibbous	Rises before sunset and sets near sunrise.
Full	Rises near sunset and sets near sunrise.
Waning Gibbous	Rises after sunset and sets after sunrise.
Last Quarter	Rises at midnight, is about due south at dawn, and sets about noon.
Waning Crescent	Rises toward the east before sunrise.

Twilight

Sudden change is very disturbing for most of us. Fortunately, the relatively slow rotation of the Earth creates a very gentle transition between our bright, busy days and dark, restful nights. The time in between is known as **twilight**. It is a period of incomplete darkness that occurs after sunset and before sunrise. For many of us, it is one of the most pleasant times of the full day.

Evening twilight ends at sunset when the Sun's center dips 18° below the horizon in the west. **Morning twilight** begins when the Sun's center reaches 18° below the horizon in the east and ends at sunrise.

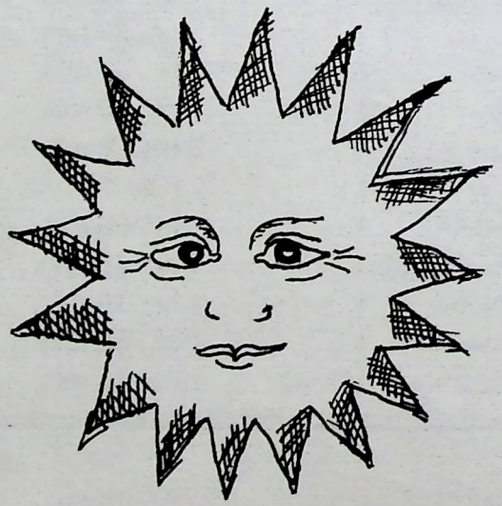
There are three kinds of twilight, with no set length of time. **Civil twilight** is the period from sunset to when the Sun is 6° below the horizon. At the end of civil twilight, bright stars begin to appear. During civil twilight, you can still read a newspaper outdoors. **Nautical twilight** is that period from the end of civil twilight to the time when the Sun arrives at 12° below the horizon. By the end of nautical twilight, the horizon is not well defined. **Astronomical twilight** follows nautical twilight, ending when the Sun is 18° below the horizon. By the end of astronomical twilight, sixth magnitude stars can be observed if weather, moonlight and street lights do not interfere.

Length of twilight in hour and minutes for Cleveland

Date		Time in Hours and Minutes
January	1	1 hr., 46 min.
February	1	1 hr., 41 min.
March	1	1 hr., 37 min.
April	1	1 hr., 40 min.
May	1	1 hr., 52 min.
June	1	2 hrs., 8 min.
July	1	2 hrs., 12 min.
August	1	1 hr., 58 min.
September	1	1 hr., 40 min.
October	1	1 hr., 36 min.
November	1	1 hr., 38 min.
December	1	1 hr., 44 min.

Note that it gets darker quicker near the times of the beginning of spring and fall. Near the summer and winter solstices, it takes the greatest amount of time to get dark once the Sun has set. The Sun sets and rises at a much steeper angle near the beginning of spring and fall and can get below the horizon more quickly.

Do not look for fifth and sixth magnitude stars before the end of astronomical twilight. To determine peak observation times, add the hours and minutes of twilight from the table on the previous page to the setting time. Or you can subtract twilight hours and minutes from the rising times of the Sun. For example: on March 1, 1996, the Sun sets at 6:17 p.m. EST and the length of twilight then is 1 hour and 37 minutes. Therefore, on March 1 the fainter stars will not be visible until 7:54 p.m. EST.



Eyes to the Skies!

The following monthly star charts will help you find chosen stars or constellations. Each chart includes stars down to the fourth magnitude. However, only stars down to the third magnitude can be easily identified, due to city light "pollution." To use the charts, follow these simple steps:

1. **Hold the star chart upside down over your head** with the south direction indicator facing south on the horizon where you live. North should be directly behind you and east should be on your left. These charts may be all you need to find a given star. But in some cases, you may want to make some calculations to assist you in getting a more precise idea of where to look. (See *For Aspiring Astronomers.*)

2. **The historical stars are referenced by number** on each month's star chart. In January, the number 23 refers to the star, μ Geminorum.

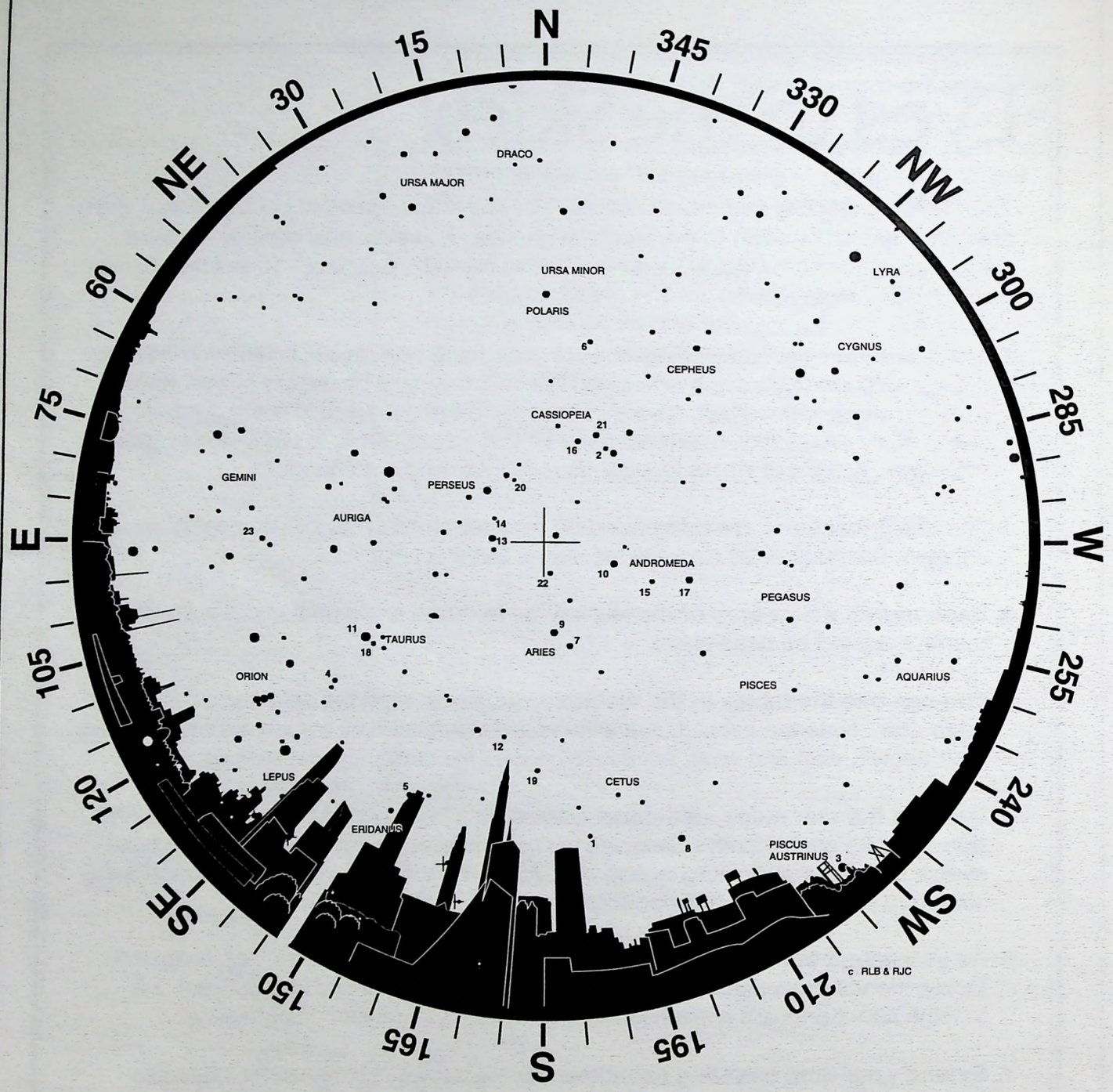
3. **Each month a new area of the sky will be featured** and a portion of the previous month's sky will be used again.

4. **You can use the tables in the resource section to read the selected azimuth for each star**. Note the azimuth and altitude are determined by a star's declination. The hour angles, east and west, are determined by the star's right ascension.

5. **Besides the star maps, additional information is provided in the resource section** to make each month's observations more interesting. There are astronomical events and general sky information cited for each month. On the pages opposite the star chart are historic events for each star.

6. **As you select stars each month, discuss the ponder points** for that month with family, friends or students. Each set of questions will draw you into the past, ask you to think about a topic's relevance today and predict its impact on our future.

7. **Extend your time traveling experience** by visiting any of our historic treasures throughout the city.



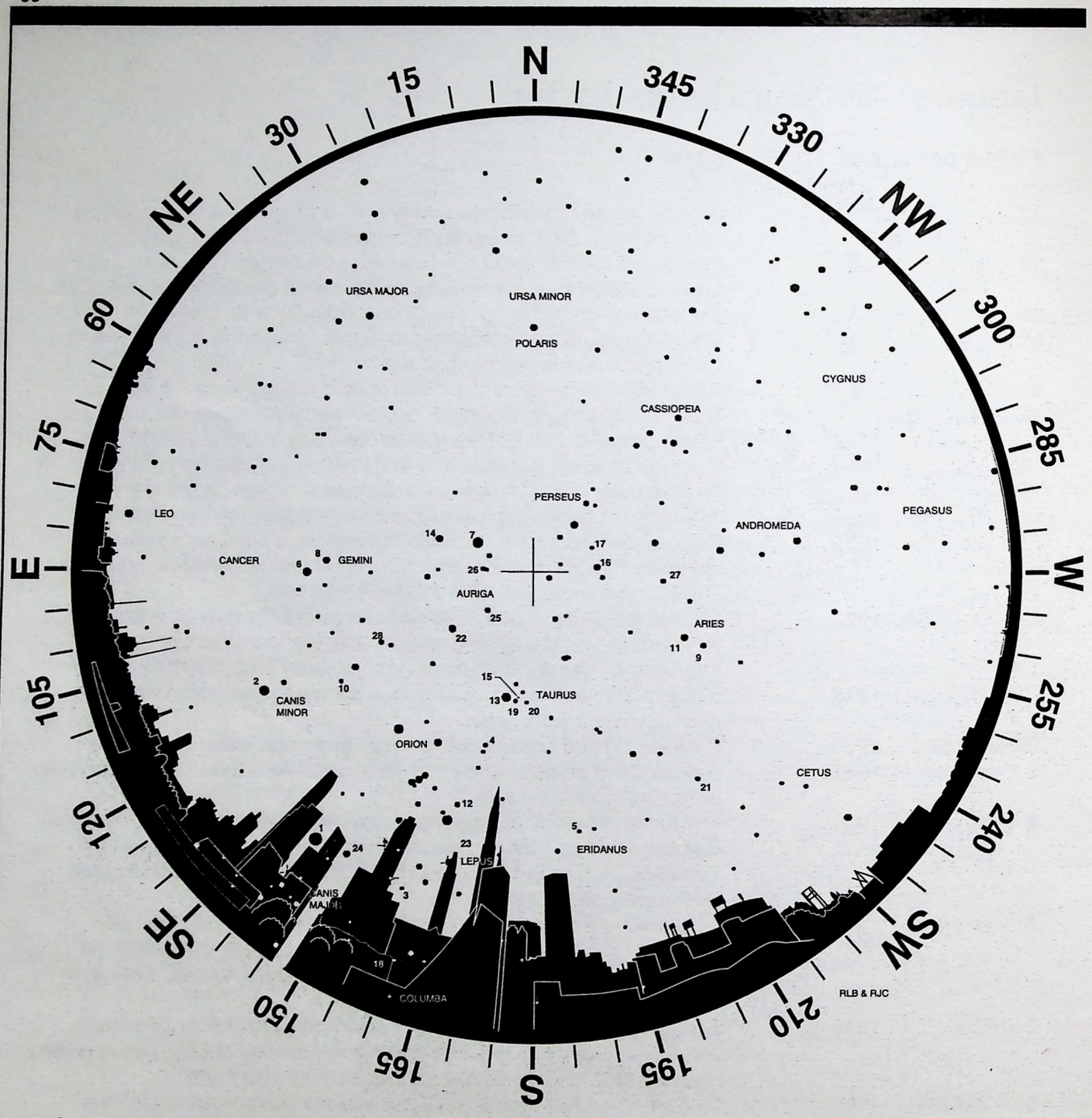
January Ponder Point

1796 – You've been traveling west for weeks along the forested shores of Lake Erie and have at last arrived at the mouth of the Cuyahoga River, or Crooked River. Your party has lost one boat in the Northwesterly. Now many in your surveying party are ill and hungry. General Cleaveland wants to determine how far this twisting, silt-clogged river can be navigated! A fog of mosquitos buzzes overhead.

- ☆ What are the hardships of slow travel? Are there benefits?
- ☆ Which modes of transportation do you prefer today? For scenic tours? Visiting far-off places? Shipping a package? Doing errands around town?
- ☆ How do you think transporation in Cleveland will change in 50 years? What are the needs for change?

January: Getting There – Faster!

# – Star name	Year (left star)	Event
23 – Mu Gem	1796	July 22: Moses Cleaveland's party arrives at mouth of the Cuyahoga River by boat. Celestial measurements used to survey and navigate.
22 – Bet Tri	1810	Ferries are used to cross rivers because no bridges have been built yet. Lorenzo Carter built the first ship in Cleveland, the Zephyr, 2 years ago.
21 – Gam Cas	1812	Shipbuilding projects begin for Commodore Perry for the War of 1812.
20 – Tau Per	1829	Ohio Canal has been completed to Akron; canal boats travel at 3-4 mph. Cleveland will enter the railroad era by 1949.
19 – Omi Cet	1869	The popular horse-drawn omnibus used is the forerunner of taxi.
18 – The2 Tau	1876	Travel by steam engine (ships, locomotives) and horse predominates.
17 – Alp And	1878	Finest passenger/freight steamer to date, City of Detroit, is built here.
16 – Del Cas	1880	Cleveland's street illumination is first in the world, easing night travel.
15 – Del And	1881	First ambulance in U.S. arrives in Cleveland. Cable car lines grow.
14 – Kap Per	1892	A. Winton will make America's first auto sale (1898); reaches 33.5 mph.
13 – Algol	1905	Cleveland-manufactured Stearns Automobile is popular. Stearns launches Cleveland Automobile Club (forerunner of AAA). Interurbans (1895) prove more cost-efficient than cable cars.
12 – Gam Cet	1927	Charles Lindbergh makes historic flight across the Atlantic in just over 30 hours. Municipal Airport, operating for 2 years, is largest in U.S. The Detroit-Superior Bridge has been open for 9 years (1918).
11 – Aldebaran	1928	5 million automobiles across the U.S. stir much dust, and massive road-paving projects begin.
10 – Bet And	1929	Cleveland Union Terminal will officially open next year.
9 – Alp Ari	1931	Development of the airplane and jet engine intensifies. Lorain-Carnegie Bridge will open next year.
8 – Bet Cet	1936	The Mercury passenger train cuts travel time from Detroit to Cleveland down to 4 hours. First pressurized passenger airplane (Boeing 307 Stratoliner) will fly in 1938 at 220 mph (354 km/h). The Main Avenue Bridge will open in 1939.
7 – Bet Ari	1941	Cleveland is a national hub for air travel. Laboratory for National Advisory Committee for Aeronautics (NACA) created to research jet propulsion, developing into NASA Lewis Research Center. First jet in the United States, the X-1, is developed.
6 – Cep	1946	Sound barrier is about to be broken (1947) at 670 mph (1,078 km/h). Jet airline passenger service will begin in the early 1950s. Ohio's widest bridge – the Innerbelt Bridge – will open in 13 years (1959).
5 – Del Eri	1965	3 years ago, Ohio-born John Glenn was the first human to orbit the Earth in an Atlas rocket, escaping gravity at 25,000 mph (40,000 km/h).
4 – Pi3 Ori	1969	July 21: Astronauts Neil Armstrong and Buzz Aldrin are first humans to walk on Moon.
3 – Alp PsA	1975	30 years after the Federal Highway Act (1945), the U.S.'s inter-city road system is best in the world.
2 – Eta Cas	1977	Concorde crosses Atlantic in 3 hours at Mach 2 (around 1,300 mph).
1 – Tau Cet	1984	First reusable commuter spacecraft (space shuttle) flies 5 different missions in 1984.



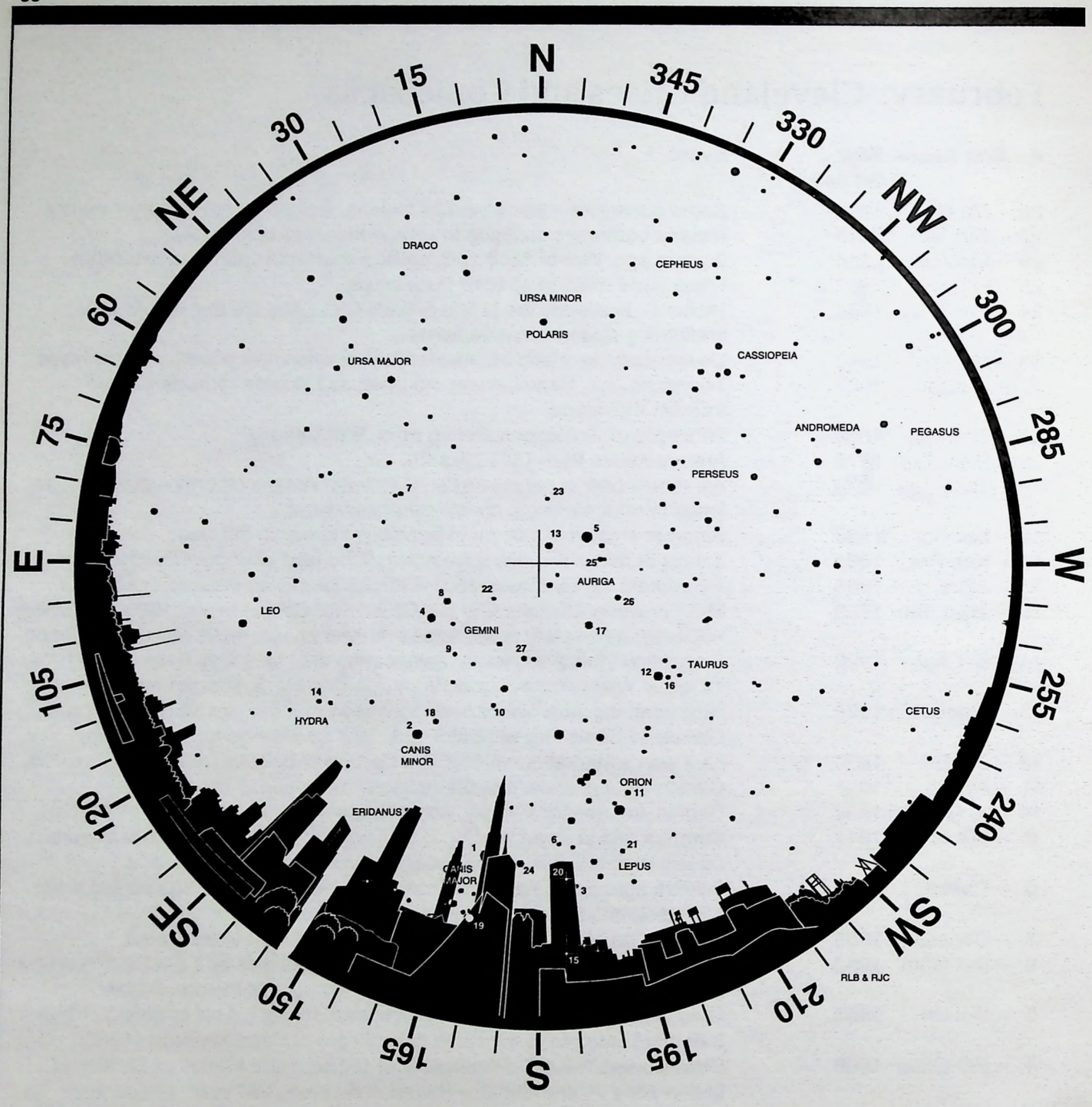
February Ponder Point

1883 – The rains of early February have made the Cuyahoga River rise over 10 feet in 24 hours! Suddenly, a tank containing 5,000 barrels of oil blows up in the Great Western Oil Works! Burning oil is spreading across the water in every direction! The night sky is lit up like an orange sunrise above these burning acres of oil.

- ☆ How would early Clevelanders have had to prepare for large-scale disasters?
- ☆ How do we prepare for the possibility of disaster today? What events are we best prepared for? What events are we ill-prepared to address?
- ☆ We've all seen disaster and science fiction movies that pit mankind against natural and human-made catastrophes. Do any seem realistic for our world 20 years from now? What can we do to prepare?

February: Cleveland Crises and Comebacks

# – Star name	Year (left star)	Event
28 – Mu Gem	1796	Some surveyors – weakened by malaria, fatigue and dysentery – mutiny.
27 – Bet Tri	1810	Malaria outbreaks continue to ravage the small community.
26 – Eta Aur	1814	2 years ago, War of 1812 split families apart, but spurred ship building.
25 – Iot Aur	1818	Freak June blizzard of 1816 froze crops.
24 – Bet CMa	1834	Martin C. Hull store fire is first serious Cleveland fire and results in firefighting system improvements.
23 – Mu Lep	1842	Devastating Cleveland weather leads to development of nat'l. weather maps.
22 – Bet Tau	1867	Two years ago, Clevelanders mourned as Lincoln's remains passed through Cleveland.
21 – Omi Cet	1869	Widespread financial suffering from "Black Friday."
20 – Gam Tau	1872	Area recovers from 1871 blizzard.
19 – The2 Tau	1876	Ashtabula bridge collapse kills 76 as train plunges off bridge during storm; leads to bridge design, construction advances.
18 – Bet Col	1888	Steamer shipwrecks occur in ferocious storms on the lake.
17 – Kap Per	1892	3 days of rain will cause devastating flood next year (see *Ponder Point*).
16 – Algol	1905	14 workers died between 1901-2 in waterworks construction accidents.
15 – The1 Tau	1906	The Fireworks Disaster and the Collinwood School Fire in 1908 (174 killed) will foster new safety procedures and awareness; replicated across nation.
14 – Bet Aur	1922	Prohibition (1919) ushers in racketeering era. May Day Riots erupt (1919). 19 die in Waterworks Tunnel Explosion (1916). G. Morgan rescues many.
13 – Aldebaran	1928	Next year, the *Shenandoah* will split apart in a thunder squall; gase ous Cleveland Clinic Fire will claim 123. Will lead to non-toxic x-ray film.
12 – Bet Eri	1930	Last year's market crash begins a decade of deflation and unemployment.
11 – Alp Ari	1931	Census figures show that Cleveland is "decaying at the core."
10 – Xi Gem	1932	Depression deepens in city; school budgets cut by $2,000,000 next year.
9 – Bet Ari	1941	Surprise raid at Pearl Harbor; U.S. enters WWII. 7 die as a freak wave 20 feet high crashes into the shore from Bay Village to Geneva.
8 – Castor	1949	5 years ago, East Ohio Gas Company tanks leaked into residential area, exploding into fire, flattening many homes.
7 – Capella	1955	5 years ago, the National Guard was called in during a blizzard.
6 – Bet Gem	1962	Next year, Clevelanders will join the nation in shock and grief as President Kennedy is assasinated during a televised parade through Dallas.
5 – Del Eri	1965	Ohio Guards will be sent into Hough area during 7 days of rioting (1966). 3 Apollo I astronauts will die in capsule fire at Cape Kennedy (1967).
4 – Pi3 Orion	1969	Clevelanders are still distraught over the separate killings of Dr. Martin Luther King Jr. and Senator Robert F. Kennedy last year. On June 22, an oil slick on the river catches on fire, setting bridges on fire.
3 – Gam Lep	1970	4 dead and 10 injured at Kent State University after National Guardsmen fire on student demonstrators protesting U.S. involvement in Vietnam.
2 – Procyon	1985	Next year, 7 astronauts, including Teacher-in-Space Christa McAuliffe, will be killed in the explosion of Space Shuttle Challenger.
1 – Sirius	1987	In 5 years, there will be 270,000 reported cases of HIV/AIDS.



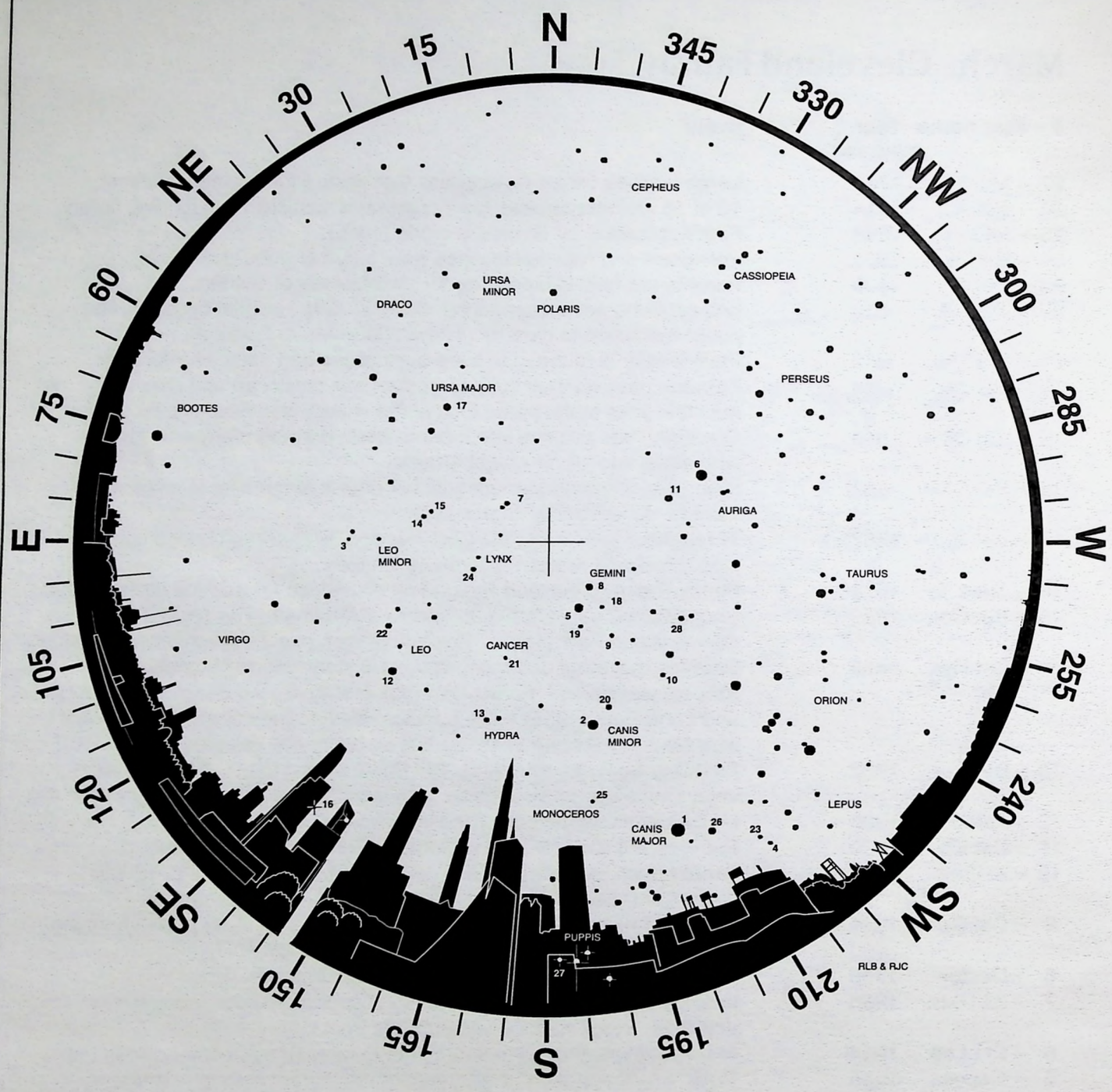
March Ponder Point

1845 – It's quiet in the house as Mother feeds the new baby. Sarah is working on her sampler, practicing new stitches and letters of the alphabet. You can hear Thomas chopping wood in the back for the fire. You eat your breakfast slowly to put off your chores a while longer. You'll work fast today because you want to race with the hoops Grandfather made for you. He and Father just left for the village to begin their work at the cooper's (barrel-maker's) shop.

- ☆ What are the benefits and drawbacks of having a large family?
- ☆ What different types of families do you see around you today? What do they all have in common? What do you do to contribute to the well-being of your family today?
- ☆ How will families look 20 years from now? How will family roles change? Which roles will stay the same?

March: Cleveland Family Tree

# – Star name	Year (left star)	Event
27 – Mu Gem	1796	Large families center on activities that ensure their frontier survival.
26 – Eta Aur	1814	16 of 18 resident families work together to establish first lending library.
25 – Iot Aur	1818	First application for divorce is made (1816).
24 – Bet CMa	1834	Immigrant and resident families work together to build services.
23 – Del Aur	1836	Parents are held liable by law for the offenses of children.
22 – The Gem	1839	Log cabin homes disappearing. In 1837, City Hospital becomes first public institution to care for children (later Metro General).
21 – Mu Lep	1842	Plain Dealer is founded to keep businesses and families informed.
20 – Del Lep	1845	Families pass on their cultural traditions in music, art and dance to maintain links to the past. First of the weekly Sun newspapers begins.
19 – Sig CMa	1849	Cleveland has evolved into a boom town, drawing many new families who settle into ethnic neighborhoods.
18 – Bet CMi	1850	Next year, a newspaper editorial will offer a formula for families who want to "Americanize" themselves.
17 – Bet Tau	1867	Throughout the 1860s, the Civil War and its aftermath brings both bloodshed and prosperity to many families.
16 – The2 Tau	1876	Penny Press (Cleveland Press) first developed for working class reader.
15 – Bet Col	1888	Shopping will begin in the architectural landmark, The Arcade. First city park is Wade Park (1882). Zoological Park (the Zoo) established (1882).
14 – Zet Hya	1898	Families move out of the city into 2-1/2 story wooden homes. Amusement parks – Forest City Park (1893), Euclid Beach Park (1895) and Luna Park (1905) – are popular. Playgrounds open (1904). West-side Market will open in 1912. Lifesavers candy invented here in 1912.
13 – Bet Aur	1922	First Boy Scout troop (1910), Girl Scout troop (1914). Families will enjoy vaudeville, movie, traditional theaters soon to be built along Euclid Ave.
12 – Aldebaran	1928	Many homes will be converted into two-family dwellings.
11 – Bet Eri	1930	Families will struggle through long periods of unemployment.
10 – Xi Gem	1932	Great Lakes Expo (1936-1937) will lift Clevelanders' spirits. Public housing will be built to meet the needs of low-income families.
9 – Del Gem	1944	Rationing rules during WWII are built into family values and upbringing. Families celebrate city's 150th birthday in 1946.
8 – Castor	1949	Cleveland pride runs high after the Browns/Indians wins.
7 – Iot UMa	1950	Interest in scholastic and professional sports provides many family activities. Large exodus into suburbs from city.
6 – Eta Lep	1954	Many mothers choose to stay home to raise baby-boomer generation.
5 – Capella	1955	Rock 'n Roll spurs on counterculture movement among teenagers.
4 – Bet Gem	1962	Cleveland Air Show entertains families. "Generation Gap" coined.
3 – Gam Lep	1970	Families struggle as sons are sent to war in Vietnam; divorce and drug use is on rise. Women's issues redefine family roles. Cuyahoga Valley National Recreation Area will be established next year.
2 – Procyon	1985	Structure of family is redefined in ways that reflect social changes: two-income families, single-parent and blended families.
1 – Sirius	1987	National focus on parenting skills and on children. Cleveland Metroparks will add reservations over the next decade.



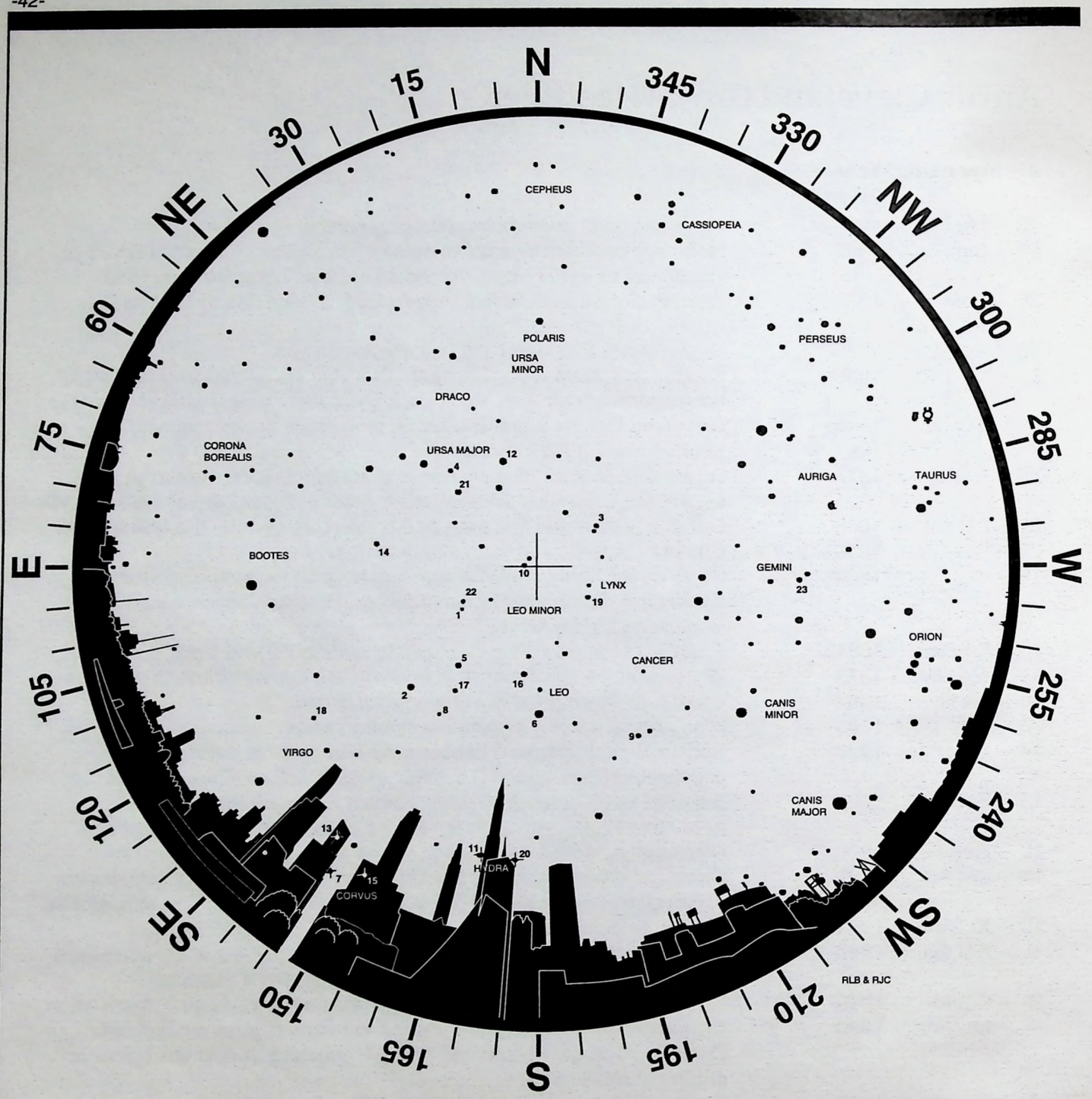
April Ponder Point

1832 – You've just heard that a terrible illness raging in Quebec has arrived in Cleveland. Cases of Asiatic cholera were aboard a troop boat returning from the Black Hawk War. A "pest house" (hospital) has been set up on Whiskey Island and a village hearse has already been purchased to transport the dead. During morning chores, as you pour out the night's waste water into the ground, you wonder in despair why these terrible illnesses happen.

- ☆ How would you try to keep your family safe from illness, back then?
- ☆ What health crises today are forcing great change in our health care system today? What do you do to protect and care for yourself and family?
- ☆ What kind of health concerns do you expect the world to face 50 years from now?

April: Cleveland Grows Healthier

# – Star name	Year (left star)	Event
28 – Mu Gem	1796	Ague and fever overwhelm surveying parties.
27 – Sig Pup	1822	Malaria is constant menace to settlers. In 5 years, Cleveland Board of Health will be established. First doctor, David Long, arrived (1810).
26 – Bet CMa	1834	Epidemic of Asiatic Cholera 2 years ago. Village has also battled typhoid over the last 7 years.
25 – Alp Mon	1835	Dr. Benjamin Strickland, the first dentist, arrives.
24 – Alp Lyn	1838	Sanitation system is non-existent. Cleveland is an education center for homeopathic physicians. Poorhouse becomes City Hospital (later rebuilt).
23 – Del Lep	1845	Cleveland Central Waterworks tries to improve health; laughing gas (nitrous oxide) tried in dentistry.
22 – Gam Leo	1846	Dr. Myra K. Merrick, first woman to practice medicine, arrived in 1841. Dr. J. Long Cassels studies whether water pollution causes typhoid fever.
21 – Alp Cnc	1848	Letheon (ether), the first anesthesia, used last year for the first time.
20 – Bet CMi	1850	Cholera epidemic last year, 130 perished.
19 – Kap Gem	1860	St. Vincent Charity (1865) will be first hospital to expand services. Babies are delivered at home routinely. Hospitals become training institutions for physicians.
18 – Iot Gam	1861	Practice of handwashing in hospitals is about 10 years old.
17 – Alp UMa	1875	Waste water is still thrown into contaminated holes, refuse into streets.
16 – Nu Hya	1884	Cleveland Training School of Nurses founded.
15 – Lam UMa	1885	High pressure water system developed; rabies vaccination developed.
14 – Mu UMa	1896	Bottled water in demand because the lake water is unsafe and unpalatable; first x-rays in U.S. taken at Case School of Applied Science.
13 – Zet Hya	1898	Baker's Dozen (later the Visiting Nurses Association) supports Antoinette Higley with supplies as she pioneers public health visits.
12 – Regulus	1909	Small pox epidemic 7 years ago traced to suspension of vaccine.
11 – Bet Aur	1922	Cleveland Clinic established (1921). American Red Cross established in Cleveland (1918); Visiting Nurses Association inspires child dispensaries.
10 – Xi Gem	1932	University Hospitals opened last year.
9 – Del Gem	1944	First antibiotic developed in the U.S. 4 years ago proves too poisonous for humans. First health museum in U.S. opened 4 years ago.
8 – Castor	1949	Last year the United Nations established the World Health Organization.
7 – Iot UMa	1950	Cleveland Clinic develops innovative coronary bypass procedures. Open heart surgery pioneered here. Pioneering work in electrocardiography at Mt. Sinai.
6 – Capella	1955	In 2 years, Blue Cross of Northeast Ohio will be formed.
5 – Bet Gem	1962	First artificial heart developed here with NASA engineers. In 1964, the first HMO in the Midwest will be set up in Cleveland.
4 – Gam Lep	1970	Babies & Children's Hospital (1925) will become Rainbow Babies & Children's Hospital next year.
3 – Xi UMa	1972	Cleveland Clinic acquires 4th CAT scan machine in the U.S.
2 – Procyon	1985	HIV/AIDS virus identified.
1 – Sirius	1987	Cleveland service providers talk about collaboration to help coordinate services for children with disabilities.



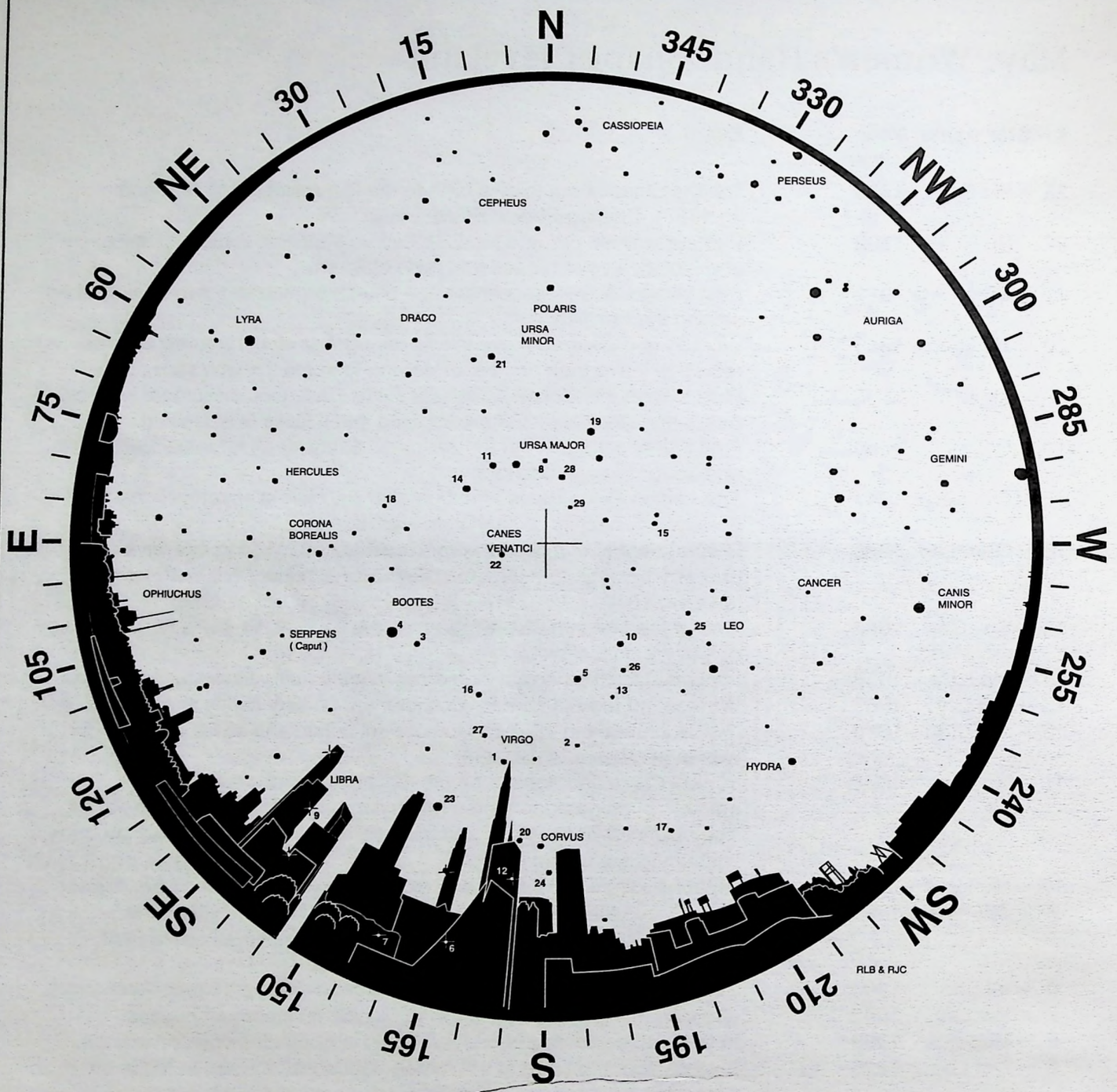
May Ponder Point

1833 – You have heard the debate heat up in gathering places in town. Should women have the right to enjoy an education? Now you learn that your rural neighbor to the west, Oberlin, addresses that question, despite stern objections. It has just opened the world's *first co-educational college* to 29 men and 15 women, without regard to their race, creed or color. Where is our world headed?

- ☆ What fears would have fueled this debate?
- ☆ What rights are women trying to expand today?
- ☆ How will the world be different 30 years from now if there is total equality between men and women at home, in the workplace and in government?

May: Women's Hands Shape Cleveland

# – Star name	Year (left star)	Event
23 – Mu Gem	1796	Tabitha Stiles about to give birth to the first resident of Cleveland (in 1797), Charles Phelps Stiles.
22 – Nu UMa	1802	Pioneer women prepare foods, preserve supplies, comb and spin wool and flaxen, weave fabrics and raise children.
21 – Gam UMa	1811	First village library association and church organizations are established among the families.
20 – Mu Hya	1813	Women and children move inland during War of 1812; a few women refuse to leave their homes, preferring to nurse the wounded.
19 – Alp Lyn	1838	Miss Lyman introduces calisthenics into the female classroom at Shaw Academy; stern objections are raised that it looks like dancing.
18 – Del Vir	1840	First salary schedule set for teachers: $10 a week for male teachers and $5 for female teachers.
17 – The Leo	1841	The Ladies Fair attracts attention after the Herald advertises that "a general attendance of bachelors was expected."
16 – Gam Leo	1846	Property rights of married women questioned; existing law says all property belongs to husband. Cleveland Academy will open for young ladies in 1848.
15 – Eps Crv	1852	One of the first female physicians in the country, Dr. Myra King Merrick, opens medical offices.
14 – Alp CVn	1858	Immigrant families look to matriarchs to learn family stories and traditions.
13 – Del Crv	1863	Women-led fund raisers for Soldier's Aid Society highly successful;
12 – Alp UMa	1875	YWCA founded in 1868 to promote education and social progress for workingwomen and mothers.
11 – Nu Hya	1884	10,000 Cleveland "ladies" employed as teachers, seamstresses, painters of china and "hired girls"; never called "women" in the 1880s. They work 50-hour weeks and are paid $5/week. In 1887, the property limitations law will be revoked.
10 – Mu UMa	1896	Rainbow Circle of King's Daughters concerns itself with needs of poor.
9 – Zet Hya	1898	Flora Stone Mather founds first settlement house. Another, the Goodrich House, initiates the Cleveland Music School Settlement, Sunbeam School and Legal Aid Society.
8 – Iot Leo	1900	The fashion of the day proves to be a great strain on women's comfort.
7 – Bet Crv	1902	Growing female volunteer effort to establish settlement houses.
6 – Regulus	1909	In 2 years, concerted efforts will begin to obtain the vote for women.
5 – Del Leo	1925	5 years ago, the League of Women Voters was formed to focus on education bills and protection laws for women and children.
4 – Del UMa	1938	Within 3 years, women will be highly involved supporting the war effort in industry and service.
3 – Iot UMa	1950	Many women stay home to raise children in suburban areas.
2 – Bet Leo	1956	Civil Rights activism spurs feminism.
1 – Xi UMa	1972	The National Organization for Women (NOW) is 2 years old; in 1970, the Equal Rights Amendment left Congress for state ratification.



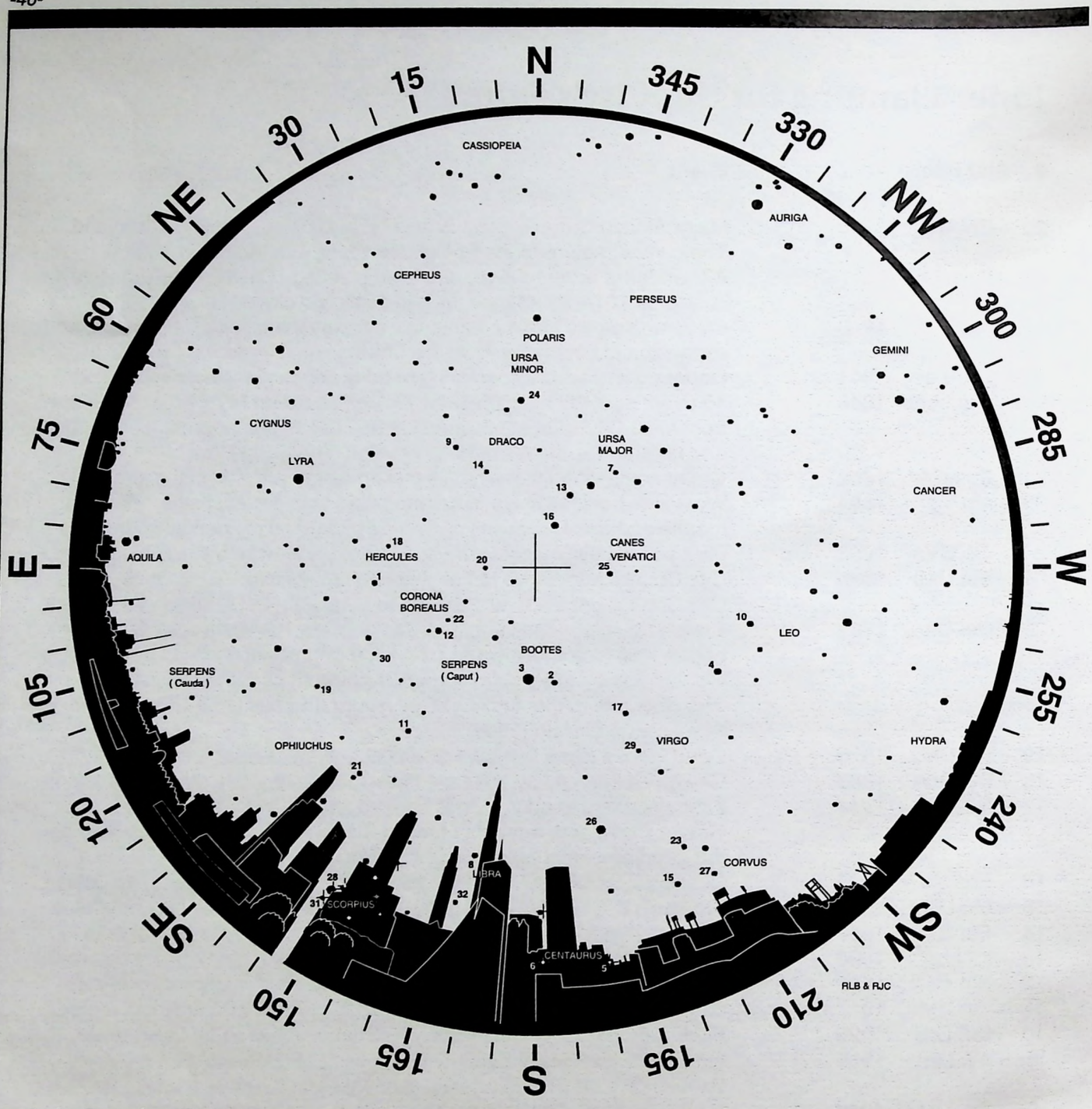
June Ponder Point

1865 – An artillery salute begins at dawn. Thousands of mourners arrive on Public Square to await the body of President Abraham Lincoln, arriving by train, enroute to its final resting place in Springfield, Ill. The hearse is drawn by six white horses to a canopied pavillion. By nightfall, 100,000 mourners have paid their respects to the former President.

- ☆ What long-lasting influence did President Lincoln have on our city and country?
- ☆ How do charismatic leaders build trust and help us catch onto their vision for our city? What ideas do you have to share with our leaders to address challenges we face in Cleveland today?
- ☆ What kinds of problems might future Clevelanders face? What proactive measures can our leaders take today to prevent these problems tomorrow?

June: Planning for Our City's Future

# – Star name	Year (left star)	Event
29 – Chi UMa	1798	Major Alonzo Carter's cabin is the first public house built in Cleveland. The central feature of the frontier hamlet is 10-acre Public Square.
28 – Gam UMa	1811	A town tax is ordered ($10) at a town meeting. Cleveland will receive its charter in 1814, its village status in 1815 and city status in 1836.
27 – Del Vir	1840	Cleveland grows into a commercial city with the influx of immigrants and expansion of commerce from the thriving canal trade.
26 – The Leo	1841	Liquor control and temperance are hotly-debated subjects in council.
25 – Gam Leo	1846	10 years ago, the building of the Columbus Street Bridge diverted trade from Ohio City, infuriating its residents. The bridge boycotting, bombing and riot that resulted is remembered as "The Bridge War."
24 – Eps Crv	1852	Ordinance passed that animals can no longer run wild in the streets.
23 – Alp Vir	1854	West side housing stays more affordable than the east side. Financial means and ethnic loyalties contribute to gradual residential segregation.
22 – Alp CVn	1858	First sewer built, inspiring the building of brick sewers in troubled areas.
21 – Bet UMi	1859	City Council addresses street cleaning problems by using chain-gangs. City Council debate over "new mode of travel": horse-drawn street cars.
20 – Del Crv	1863	Cleveland celebrates its "grand Union victory." 2 years after Civil War began (1861), a Clevelander relays the Emancipation Proclamation from Washington by telegraph. John Wilkes Booth performs in Cleveland in *The Robbers*. 5 months after Gettysburg Address (1864), Booth will assassinate Lincoln (1865).
19 – Alp UMa	1875	Court House is the first built of almost entirely fireproof materials.
18 – Bet Boo	1883	City given the right by the state legislature to regulate smoke emissions.
17 – Nu Hya	1884	First electric railroad in U.S. is opened for public use – 1 mile long. Grover Cleveland, related to Moses Cleaveland, will be inaugurated as the 22nd president of the United States next year.
16 – Eps Vir	1895	Descendant of Seth Pease awarded prize for her Cleveland flag design.
15 – Mu UMa	1896	Women's Day, Early Settlers Day and Western Reserve Day promoted.
14 – Eta UMa	1897	City equipped with new street sign, refered to as "signs of progress."
13 – Iot Leo	1900	Water-works tunnels extend deeper into the lake after typhoid outbreak.
12 – Bet Crv	1902	Council gives $4,000 for smallpox research after smallpox epidemic.
11 – Zet UMa	1917	U.S. declares war on Germany (April 19). Metroparks District created.
10 – Del Leo	1925	First traffic signal provokes such fascination it has to be taken down.
9 – Alp Lib	1935	First sales tax, Social Security Act passed. Successful Great Lakes Expo shows off Cleveland's achievments and future potential.
8 – Del UMa	1938	New Cleveland City Plan develops into "Cleveland on Parade" event.
7 – The Cen	1940	Cleveland Metropolitan Housing (CMHA) works to eliminate substandard housing.
6 – Iot Cen	1942	War drives and rationing sweep city during WWII. City dim-outs ordered.
5 – Bet Leo	1956	Continued exodus from the city as crime worsens, businesses deteriorate.
4 – Arcturus	1959	Urban renewal plans (for public housing, also) are largest in country.
3 – Eta Boo	1960	Erieview, an urban plan to reduce blight and decay, is underway.
2 – Bet Vir	1961	Businesses are following residents into the suburbs.
1 – Gam Vir	1963	Planning and civic pride will transform Cleveland into "America's Finest City."



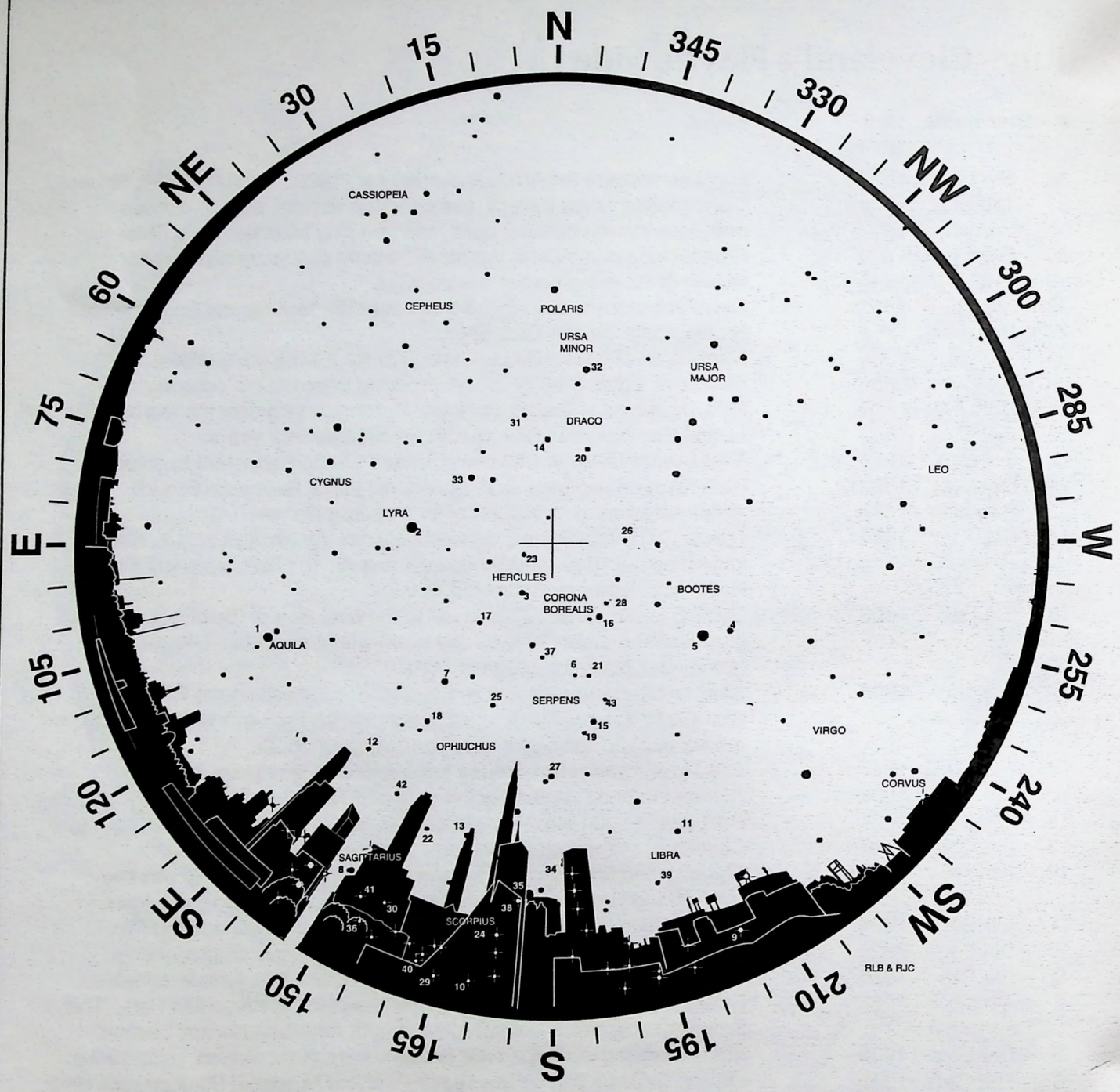
July Ponder Point

1995 – You've waited all your life for this season. Your grandfather, who attended games at League Park and the Stadium, says, "I remember the '48 World Series." Your mom accompanied him to games in the 40s and 50s. They've told you about Boudreau, Doby, Paige, Harder, Feller. You had your own idols – Colavito, Thornton, Leon, Manning, Hargrove, Bell. Now, in Jacobs Field, your children cheer for theirs: Baerga, Lofton, Belle, Murray, Vizquel, Thome . . .

- ☆ How different were fans and the focus of cities on their teams in the early part of this century? During the Great Depression?
- ☆ How has the rejuvenation of Cleveland sports affected the city today?
- ☆ What role will sports and play – leisure time – have in the next century?

July: Cleveland's Playful Side

# – Star name	Year (left star)	Event
32 – Sig Lib	1828	Families prepare for Cleveland's first fair (1829), held on Public Square.
31 – Tau Sco	1831	Communities enjoy picnics, berry-picking socials, square dances, quilting and corn husking bees; children play Marbles, Ante Over.
30 – Gam Her	1833	Frontier skill games are organized: turkey shoots, group hunts.
29 – Del Vir	1840	Winter horse-sleigh races are popular.
28 – Antares	1851	Cleveland Jockey Club formed last year for "trotting and pacing" races.
27 – Eps Crv	1852	St. George's Cricket Club opens.
26 – Alp Vir	1854	Ivanhoe Boat Club will open next year for rowing competition.
25 – Alp Cvn	1858	First prize fights (1863). Sport wrestling is popular in schools.
24 – Bet UMi	1859	Billiards played at Brainard's Hotel. Hunting, fishing become recreational.
23 – Del Crv	1863	Forest City Baseball Club (amateur) will form in 2 years.
22 – Bet CrB	1879	First bowling alley in Cleveland; others are built attached to saloons.
21 – Del Oph	1882	Rollerskating expands skating options; Wade Park established.
20 – Bet Boo	1883	Tennis is growing in popularity for men and women.
19 – Kap Oph	1887	Forest Citys established, affiliated with the American League, also known as the "Beer and Whiskey" League. In 1889, team will move to National League as Cleveland Spiders.
18 – Eta Her	1893	Cycling craze since 1870s leads to the evolution of the bicycle, from high-wheel ordinary to two- and three-wheel versions. League Park (trolley-car stadium) opens in 1891.
17 – Eps Vir	1895	Samuel Mather brings golf to Cleveland, establishing the Cleveland Golf Club; Spiders finish in 3rd place; YMCA (1854), YWCA (1868) further expand recreational opportunities for youth.
16 – Eta U Ma	1897	Alta House and Hiram House bring sports to immigrant families.
15 – Bet Crv	1902	Autoracing and harness racing gain popularity.
14 – Iot Dra	1911	Park district soon will advocate for legislation to conserve resources.
13 – Zet UMa	1917	Cleveland Metropark District created by William Stinchcomb.
12 – Alp CrB	1921	Cleveland Indians enter '21 season with high hopes, after winning 1920 World Series (Oct. 12, 1920). "Age of the Spectator" begins.
11 – Alp Ser	1924	Bulldogs win Cleveland's first professional football championship.
10 – Del Leo	1925	Rosenblums win first American Basketball League championship.
9 – Eta Dra	1926	School sports grow, but incorporate "girls rules" for female athletes.
8 – Alp Lib	1935	Roads, trails, shelters, bridges built in Cleveland Metropolitan Park. The Barons (1936) become charter member of American Hockey League.
7 – Del UMa	1938	Social dancing in dance halls is major form of recreation 1920-1950s.
6 – The Cen	1940	Indians continue playing at League Park and Municipal Stadium until 1947.
5 – Iot Cen	1942	Sports dynasties begin in Cleveland: in football, Rams will clinch title (1945), Browns will win All-American title (1946); in baseball, Buckeyes will win league pennant (1947), the Tribe will win World Series (1948).
4 – Bet Leo	1956	2 years ago, Indians won a record 111 games, but got swept in the World Series. Legendary Indians' pitcher Bob Feller retires this year.
3 – Arcturus	1959	Tribe manages second place finish.
2 – Eta Boo	1960	Recreational boating will lead to revitalization of "Flats" in 20 years.
1 – Zet Her	1964	Browns win National Footbal League title.



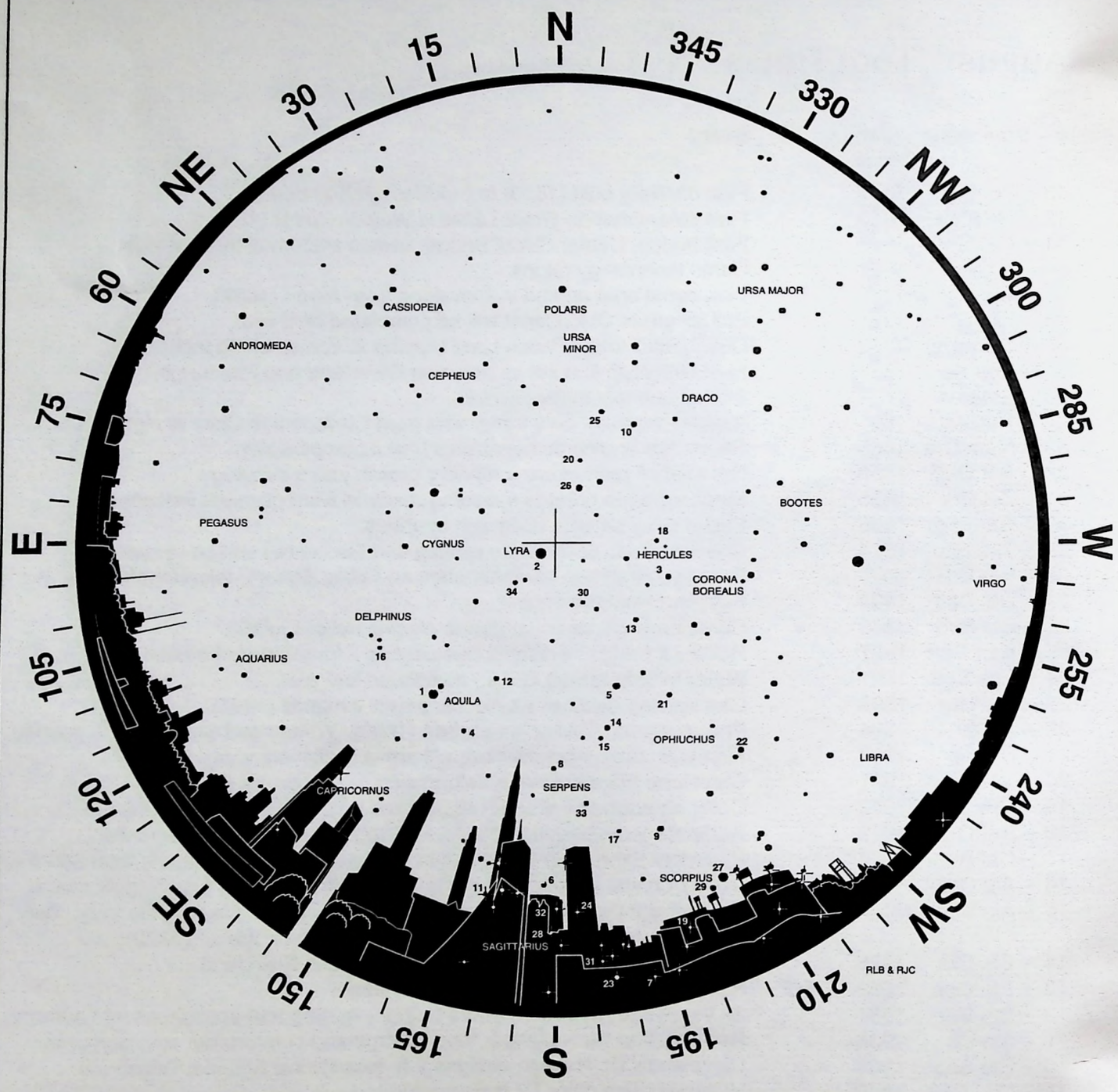
August Ponder Point

1969 – On the TV screen, ghostly shapes against an ink black sky silence everyone in the room. No one breathes. *It is really happening!* Like underwater divers, hooded astronauts slowly walk on the Moon, over 200,000 miles away. And you are watching it happen — in your living room! Your future may seem as far off as the Moon right now. But today, your wildest dreams suddenly seem possible.

- ☆ What spin-offs in technology, education and medicine did those missions to the Moon create?
- ☆ Since tools make it easier for human beings to work and enjoy their lives, which new technologies make it possible for you to reach for a dream of your own?
- ☆ What kind of technology will make life more safe, comfortable, balanced and fulfilling 50 years from now?

August: Tool Times

# – Star name	Year (left star)	Event
43 – Del Ser	1804	First distillery built (1800) to produce gin and brandy.
42 – Nu Oph	1820	First steamboat on Great Lakes is Walk-In-Water (1818).
41 – Del Sgr	1823	First bridge, Center Street Bridge, uses a system of floating logs.
40 – Iot Sco	1824	Canal technology reigns.
39 – Sig Lib	1828	First canal boat arrived in Cleveland from Akron (1827).
38 – Tau Sco	1831	Full length of Ohio Canal will be completed next year.
37 – Gam Her	1833	Cuyahoga Furnace adds blast blowing to iron smelting technology.
36 – Eps Sgr	1847	First telegraph line set up between Cleveland and Pittsburgh.
35 – Antares	1851	First steam locomotive arrives.
34 – Nu Sco	1853	"Lightening train" cuts travel time from Cleveland to Cinci to eight hours.
33 – Gam Dra	1855	Steam fire engine demonstrates how it pumps water.
32 – Bet UMi	1859	National oil rush spawns refinery growth and technology.
31 – Zet Dra	1865	Mechanization creates a leading ready-to-wear garment industry.
30 – Gam Sgr	1866	Elisha Gray patents telegraph aparatus.
29 – The Sco	1874	Charles Brush patents arc lighting and the central station dynamo.
28 – Bet CrB	1879	Brush's streetlamp demonstration on Public Square; telephone (1877).
27 – Del Oph	1882	First chemical fire engine.
26 – Bet Boo	1883	Horse cars will be converted to electric trolleys in 1887.
25 – Kap Oph	1887	Roller-lift bridge. Edison's kinetoscope – forerunner of motion pictures.
24 – Eps Sco	1891	Water inlet tunnel (9,117 ft.) completed last year.
23 – Eta Her	1893	Gas lighting declines as electric power expands (1895).
22 – Xi Ser	1894	Phonographs; Electric Interurban (1895). Winton and Stearns cars popular.
21 – Bet Ser	1907	First U.S. radio transmission; will arrive in Cleveland in 1922.
20 – Iot Dra	1911	Cleveland pioneers water chlorination.
19 – Eps Ser	1912	Color photography first developed; will be in wide use by the thirties.
18 – Bet Oph	1913	Radio transmission leads to many developments in communication.
17 – Del Her	1914	Electrical Expo. puts Cleveland in nat'l. spotlight. Water mains total 985 mi.
16 – Alp CrB	1921	Quartz crystal improves radio transmission, leading to future applications.
15 – Alp Ser	1924	"City of Light" demonstration; Cleveland called the Great White Way. Two years ago, city's first radio station, WHK, went on the air (1922).
14 – Eta Dra	1926	Air travel – freight and passenger – booms in Cleveland.
13 – Eta Oph	1933	Kitchens modernized by new appliances.
12 – Eta Ser	1934	12 years ago, turbogenerators brought lighting and appliances into suburbs.
11 – Alp Lib	1935	Refrigeration allows longer food storage and comfortable environments.
10 – Eta Sco	1939	Cleveland's Dr. Nassau designs 2-ft. lens for 1st Schmidt Telescope.
9 – The Cen	1940	High-definition color TV is demonstrated.
8 – Lam Sgr	1943	NACA researching aeronautic technology (1943).
7 – Alp Oph	1945	City's first television station, WEWS-TV5, debuts (1947).
6 – Gam Ser	1957	Aerospace technology: Russians launch Sputnik.
5 – Arcturus	1959	Jupiter C, first U.S. satellite launched (1958), begins Space Race.
4 – Eta Boo	1960	Ultrasound expands expertise in diagnosis, reduces exploratory surgery.
3 – Zet Her	1964	Satellites technology improves communication and navigation.
2 – Vega	1971	Word processors start to replace typewriters.
1 – Altair	1980	The personal computer age is dawning.



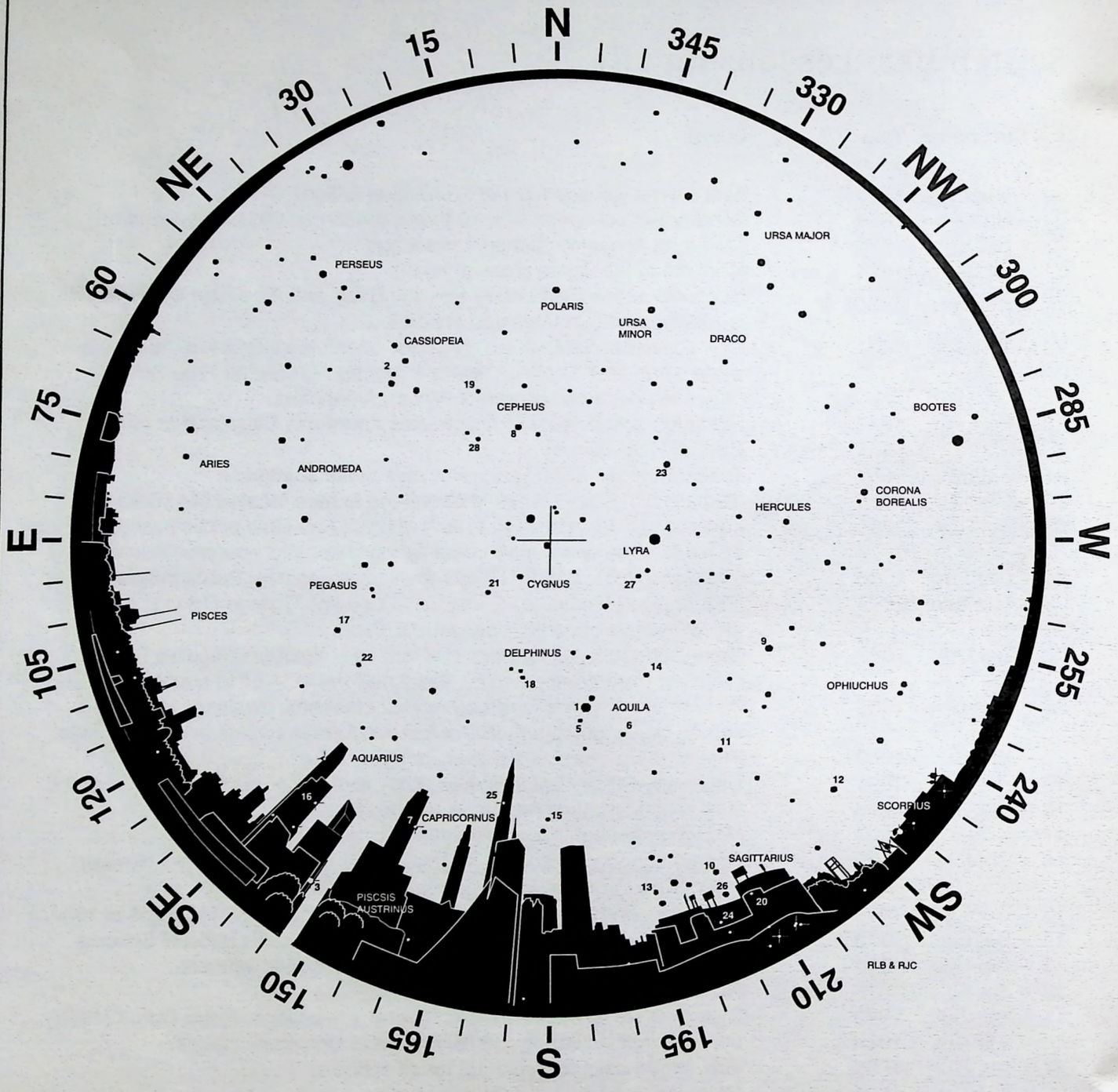
September Ponder Point

1840 – You write the answer on a slate in your seat, facing the log walls of the schoolroom. What a great day! You're not too close to the box stove and not too far from its warmth. Sun glows through the grease-paper windows a few feet over your head. And you know the answer to the problem! When called on, you stand up, whirl around to face the teacher, give your answer and turn back to your seat. The younger ones in the class look over to you in admiration.

- ☆ How would you try to educate a group of children from 4 to 21 years old in the same classroom?
- ☆ How are today's classrooms similar to/different from one-room schoolhouses? What different ways do we address children's many learning needs?
- ☆ How will we pass on information and knowledge 50 years from now?

September: Lessons for Life

# – Star name	Year (left star)	Event
34 – Gam Lyr	1815	First school will open in 1817, charging tuition.
33 – Nu Oph	1820	Sunday School opens with 40 pupils (becomes Old Stone Church).
32 – Del Sgr	1823	Cleveland Academy opened 2 years ago.
31 – Iot Sco	1824	Most education takes place at home.
30 – Xi Her	1827	Noah Webster's Elementary Spelling Book and American Dictionary is widely used in homes and schools.
29 – Tau Sco	1831	First co-ed course (natural sciences) opens to students; in 1833, the world's first co-ed college opens (Oberlin). Cleveland Free School opens to educates children of African Americans.
28 – Eps Sgr	1847	First high school west of Alleghenies opened in Cleveland in 1845: Central High School.
27 – Antares	1851	Teachers make $550/year; principals make $650/year.
26 – Gam Dra	1855	"Buffalo Bill" Cody comes to Cleveland to be educated (14 years old).
25 – Zet Dra	1865	Law passed 13 years ago (1852) created free Ohio public schools, funded by taxes. The law was fathered by legislator and educator Harvey Rice.
24 – Gam Sgr	1866	Cleveland Public Library (1869) opens, evolving from Public School Library.
23 – The Sco	1874	First chartered college for women is Ursuline College (1871). School for "disruptive children" opens in 1877.
22 – Del Oph	1882	Case School of Applied Science founded. Western Reserve College (1826) moves adjacent to it. The 2 merged in 1967 to become CWRU.
21 – Kap Oph	1887	30 schoolrooms are in rented rooms (churches, dwellings, etc.), 9 in saloon buildings, others in storerooms, former stables and social halls.
20 – Xi Dra	1889	Free kindergarten started 2 years ago.
19 – Eps Sco	1891	University School established (1890); forerunner of country day school.
18 – Eta Her	1893	Businesses request hands-on training for students.
17 – Xi Ser	1894	"Manual training" begins for students, leading to technical schools.
16 – Bet Del	1899	Private schools Laurel (1896), Hathaway Brown (1886) and Hawken (1915) are founded, following the academic movement.
15 – Gam Oph	1901	Vacations and playgrounds soon added to schools; PTA begins in 1902.
14 – Bet Oph	1913	Afternoon schools preceded founding of Cleveland Hebrew Schools.
13 – Del Her	1914	Cleveland Foundation surveys the state of public schools.
12 – Zet Aql	1918	School population is 106,862.
11 – Tau Sgr	1920	Sisters of Notre Dame will start liberal arts college, Notre Dame (1922).
10 – Eta Dra	1926	John Carroll University (1886) moved to University Heights.
9 – Eta Oph	1933	Gov. White asks for state aid for all schools.
8 – Eta Ser	1934	Parochial schools will continue to grow over next 20 years.
7 – Eta Sco	1939	Open air classes will be formed to fight tuberculosis next year.
6 – Lam Sgr	1943	30 years ago, Baldwin University and Wallace College merged.
5 – Alp Oph	1945	In 14 years, Cleveland's first Montessori school will be opened.
4 – Del Aql	1952	Affordable higher education will be offered over the next decade.
3 – Zet Her	1964	New focus on language, sciences, teaching methodologies.
2 – Vega	1971	Desegregation attempts to spread education opportunities more equitably.
1 – Altair	1980	Individuals with Disabilities Education Act will be passed in 6 years.



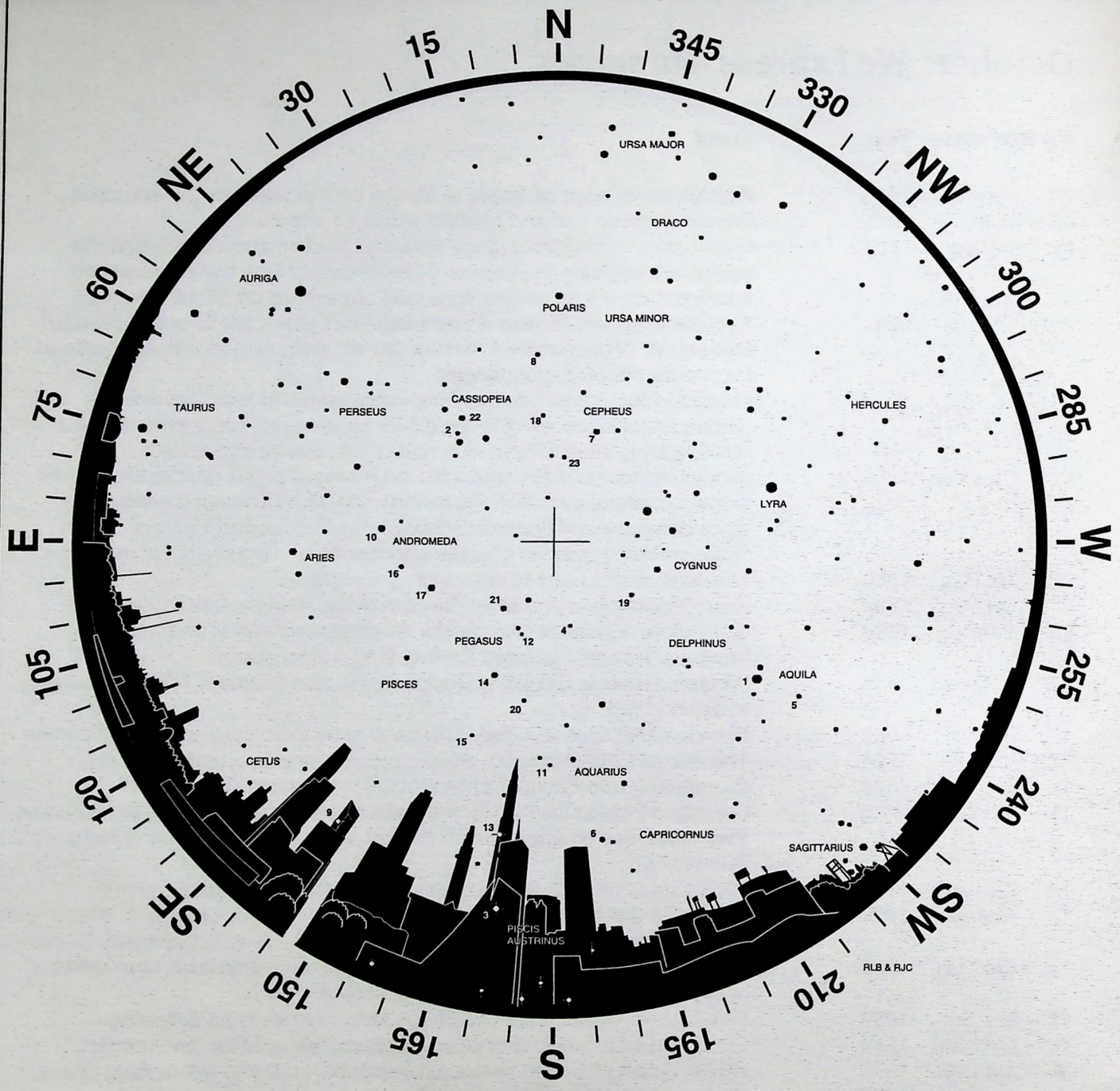
October Ponder Point

1851 – The people in the hall sit breathless as "the Swedish Songbird," Jenny Lind, begins her song. Her beautiful voice flutters through the hall like a bird. Onlookers peer through the glass dome ceiling overhead, pressing so hard that – Crash! – several onlookers fall through the glass. The audience erupts into panic. Lind takes control of the situation, and begins to sing above the uproar. The audience is calmed and the injured are attended to.

- ☆ What role did the arts and literature play in 19th-century America?
- ☆ How do today's composers, writers, artists and actors influence our thoughts, feelings, beliefs and attitudes?
- ☆ How will developing electronic technology shape the arts in the coming century?

October: We Express Ourselves

# – Star name	Year (left star)	Event
28 – Zet Cep	1797	First violin will soon be heard at "Grand Ball" in Lorenzo Carter's cabin.
27 – Gam Lyr	1815	Frontier families visit and perform works for one another.
26 – Del Sgr	1823	Blanchard's visiting troup gives theatrical performance; first Cleveland author writes *Catherine Brown: The Converted Cherokee* – published anonymously, it was written "by a lady"; book sold for 12-1/2 cents.
25 – Eps Aqr	1832	First piano arrived in town 4 years ago. In 5 years, the Cleveland Mozart Society will be founded for "refined" tastes; also, the Cleveland City Band for popular music performances.
24 – Eps Sgr	1847	Musical entertainment comes from visiting groups; new Cleveland Library Association will provide lecture series next year; immigrant families bring their cultures' folk music, art, theatre and dance.
23 – Gam Dra	1855	Jenny Lind tour of 1851 marks the beginning of public appreciation of the arts and cultural growth in Cleveland. Cleveland Theater develops first stock company and dramatic school in the U.S.; seventh annual "Saengerfest" hosted in Cleveland (gathering of German singing society).
22 – Zet Peg	1862	Fine arts events used to raise money for charity.
21 – Zet Cyg	1864	Silas Brainard first publishes Western Music World, a monthly journal.
20 – Gam Sgr	1866	S. Brainard & Sons is Cleveland's leading music dealer and publisher. Western Reserve Historical Society (1867) is founded.
19 – Iot Cep	1871	Western Reserve School of Design for Women founded, 1882 (Cleveland Institute of Art).
18 – Bet Del	1899	Cleveland Art Club founded. City soon to become commercial arts center.
17 – Alp Peg	1904	The Hermit Club is formed, drawing professional and amateur talent.
16 – Del Aqr	1908	Cleveland Music School Settlement (1912); Kokoon Club (1911).
15 – Alp Cap	1915	Cleveland Playhouse (1915), the nation's oldest resident theater company; Playhouse Settlement (Karamu House) soon formed; Cleveland Museum of Art (1913).
14 – Zet Aql	1918	Cleveland Orchestra first performs under Nikolai Sokoloff.
13 – Tau Sgr	1920	Cleveland School of Music opens (Cleveland Institute of Music). May Shows begin (1919). Natural History Museum opens in University Circle.
12 – Eta Oph	1933	Severance Hall opens to the public. Superman comic book hero created by high school students Siegel and Schuster.
11 – Eta Ser	1934	Pick-Quick Club begin to encourage local interest in art collecting.
10 – Lam Sgr	1943	Cleveland-born comic Bob Hope builds morale at home and abroad.
9 – Alp Oph	1945	WTAM is first station to broadcast orchestral concerts with school choirs.
8 – Alp Cep	1947	Rhythm 'n Blues gaining popularity.
7 – Del Cap	1948	Langston Hughes has been writing about African-American experience since 1921.
6 – Del Aql	1952	D.J. Alan Freed's "Moon Dog Coronation Ball." He coins "Rock 'n Roll."
5 – Bet Aql	1953	Cleveland pioneers innovative radio programming, playing live concerts.
4 – Vega	1971	Cleveland Ballet will be founded next year and will perform first in 1976.
3 – Alp PsA	1975	Cleveland Opera formed to be city's resident producing opera company.
2 – Eta Cas	1977	First movie filmed in Cleveland: "Deer Hunter."
1 – Altair	1980	Cleveland Chamber Symphony forms.



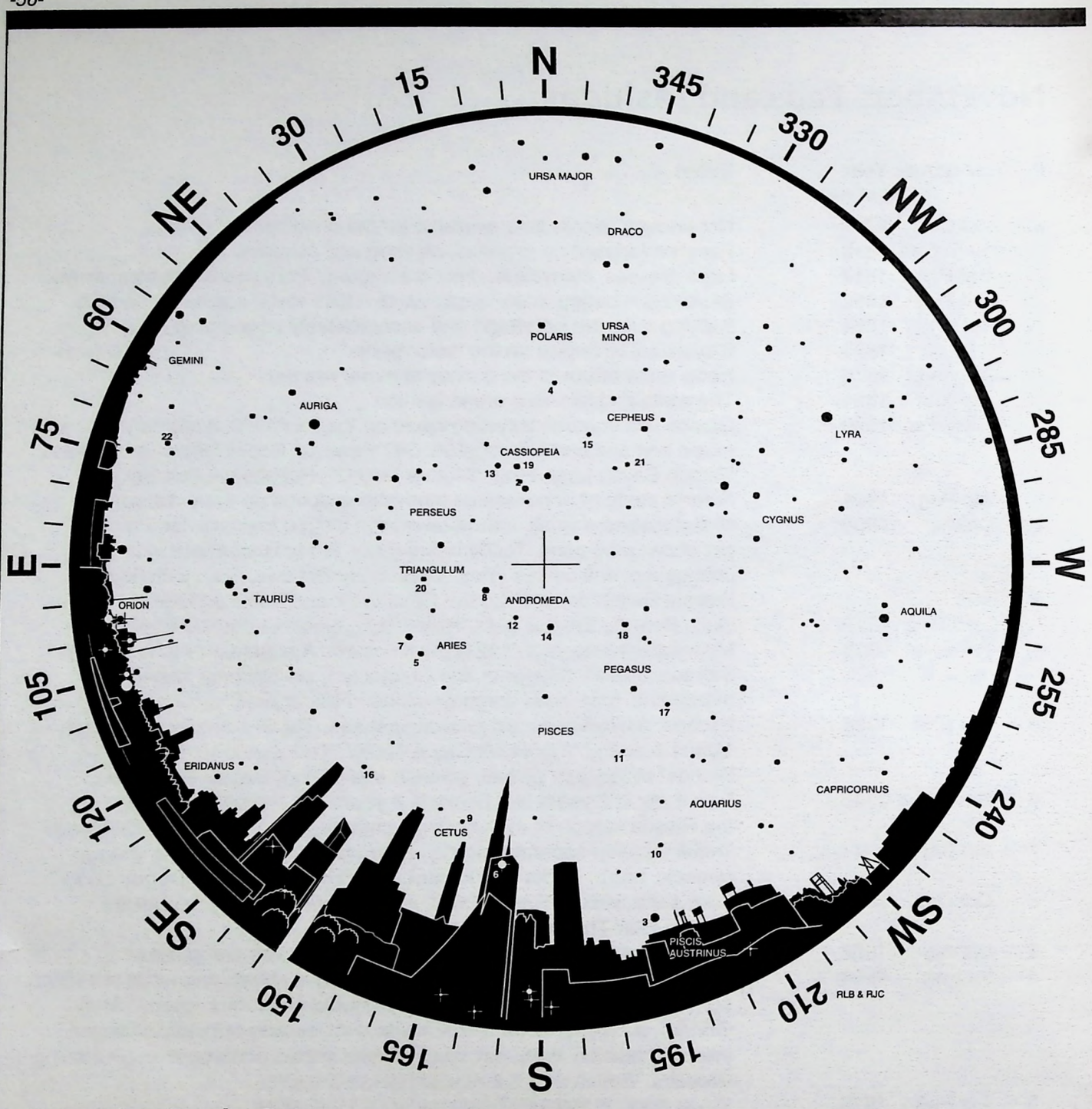
November Ponder Point

1895 – Grown-ups take so long to dress! All those long laces that have to be fastened in Mother's dresses, shoes and gloves. Father must layer everything; now, he's searching out his favorite stickpin while you wait in the hallway, fidgeting in your own frilled sleeves, curls spilling out under your brimmed hat.

- ☆ What would your clothing say about your family back then?
- ☆ What fads are equally uncomfortable today? What are you embarrassed about having worn five years ago? What clothing style or popular past time do you enjoy today? Why do you think we are looking back to fads from other decades?
- ☆ What human needs might fads address 20 years from now?

November: Fads and Fashions

# – Star name	Year (left star)	Event
23 – Zet Cep	1797	Not enough leisure time available for the development of fads.
22 – Gam Cas	1812	Families focused on practical, clothing and activities.
21 – Bet Peg	1817	Light dresses, sleeveless. Hair cut shorter. Pantaloons will soon arrive.
20 – Zet Peg	1862	Bloomers – baggy, knee-length pants – lead revolt against hoop skirt.
19 – Zet Cyg	1864	Bathing suits are full length and uncomfortably slow drying.
18 – Iot Cep	1871	Bicycle craze begins on the "velocipede."
17 – Alp And	1878	Hoop skirts return to the dismay of many women.
16 – Del And	1881	The waltz and two-step are in fashion.
15 – Gam Psc	1890	Gibson Girl apparel; bicycling craze on the "high-wheel ordinary"; music box and first phonograph; 3-D viewers; Kodak "Brownie" camera, "Simon Says"; Leap Frog; "Mother May I?"; Hopscotch; Fair-goings.
14 – Alp Peg	1904	Freud's study of unconscious motivations opens up lively discussion.
13 – Del Aqr	1908	Nickelodeons – small, individual motion picture machine for a nickle per show; ping pong, Teddy bears (after Teddy Roosevelt); mail-order catalogues; doll crazes (Tiny Tears, Baby Bubbles, Saucy Walker, Kewpie Dolls); dances like the Cake Walk and Polka popular.
12 – Lam Peg	1919	Ouija Boards, Erector Sets, Tinker Toys, Lincoln Logs; silent pictures.
11 – Gam Aqr	1923	Miss America contest (1921). Train craze. Amusement Parks.
10 – Bet And	1929	Self expression. Flappers, the Charleston, the Shimmy; dance marathons, foot races, flagpole sitting. First "talkies."
9 – Bet Cet	1936	Escape. Hollywood movie extravaganzas. Radio series are the rage: "Amos & Andy," "Fibber McGee & Molly," "The Shadow"; "War of the Worlds" broadcast; pinball, goldfish swallowing, Mickey Mouse.
8 – Gam Cep	1946	Silly Putty is 2 years old; Slinky is 3 years old; Pin-up girls, Rosie the Riveter is icon of the working woman in war time; nylons; Dr. Spock.
7 – Alp Cep	1947	Teens develop separate identity, wear special "teen" clothing (baggy sweater, bobby socks and loafers). TV hit: "The Howdy Doody Show."
6 – Del Cap	1948	Zoot suits; "Kukla, Fran & Ollie"; variety shows like "Milton Berle's Texaco Star Theater."
5 – Del Aql	1952	3-D glasses offered to moviegoers for specially-filmed movies.
4 – Iot Peg	1958	Hula Hoop, frisbee, "counter culture" emerges; black and white television series like "I Love Lucy," "Father Knows Best," "Donna Reed," "Andy Griffith"; drive-ins; Rock 'n Roll music evolves with dramatic changes, inspiring fashion every few years; dance crazes continue through coming decades. Barbie dolls are new icon for young girls.
3 – Alp PsA	1975	Mood rings, streaking, Transcendental Meditation.
2 – Eta Cas	1977	CB radio language; disco music, apparel and dance steps; pet rocks Star Wars, mopeds, leisure suits, "prime time TV."
1 – Altair	1980	Rubic's Cube; shopping as recreation; New Age movement; Madonna and Michael Jackson create clothing fads; tanning salons, Nintendo, Cabbage Patch Dolls, Teenage Mutant Ninja Turtles.



December Ponder Point

1936 – In front of 120,000 spectators, Cleveland track star Jesse (James Cleveland) Owens smashes Hitler's myth of Arian Superiority! The "fastest human" wins 4 gold medals at the Berlin Olympic Games. Hitler refuses to shake Owens' hand.

- ☆ As immigrants from throughout the world poured into Cleveland to settle down and raise families, how did people already living here adjust their attitudes and beliefs?
- ☆ Who are the newest immigrants in our city? How can we work together to build bridges of understanding between all groups of people?
- ☆ How do you picture our multicultural, multiracial city in 50 years?

December: Celebrating the Strength of Diversity

# – Star name	Year (left star)	Event
22 – Mu Gem	1796	Ottawa Indians are seasonal visitors to settlers.
21 – Zet Cep	1797	Lorenzo Carter, first resident of Cleveland, barters with Indians.
20 – Bet Tri	1810	George Peake, the first African-American settler, arrived last year.
19 – Gam Cas	1812	British culture influences village planning.
18 – Bet Peg	1817	In the 1920s, influx of German and Irish families will help build Ohio Canal; British, Scots, Welsh will arrive in 1830s. Underground Railway, including the Oberlin-Wellington Rescue, helps fugitive slaves to freedom.
17 – Zet Peg	1862	Cleveland's oldest service organization, B'Nai B'rith (1853), founds Belle Faire, a residential home for children.
16 – Omi Cet	1869	Immigrants bring new skills, folk influences from their countries.
15 – Iot Cep	1871	Scandinavian, Italian, Hungarian, Polish, Slovenian, Slovak and Croatian settlers arrive throughout the next 50 years.
14 – Alp And	1878	Cleveland Art Club founded by sons of German immigrant.
13 – Del Cas	1880	Many immigrants arrive to work, not settle.
12 – Del And	1881	Soon Rabbi Moses Gries will advocate for charitable activities, founding the Citizens League of Cleveland, highly active in ecumenical affairs.
11 – Gam Psc	1890	Legendary American Indian Louis "Chief" Sockalexis plays for Cleveland Spiders. Alta House serves Italian immigrant women, Hiram House serves Eastern European Jewish immigrants.
10 – Del Aqr	1908	Mt. Sinai Medical Center develops out of Young Ladies Hebrew Association to care for "needy and sick." African-American Garrett Morgan will invent life-saving gas mask in 1912 (used inWaterworks Tunnel Explosion and WWII), and the modern traffic light (1923).
9 – Eta Cet	1916	Almeda Adams, blind since birth, founded the Cleveland Music Settlement, 5 years ago. Oghema Niagara, or "Chief Thunderwater," is active in education about American Indians' culture and plight.
8 – Bet And	1929	African-American poet Hart Crane and poet/writer/playwright Langston Hughes will become major 20th century literary figures.
7 – Alp Ari	1931	Polish communities at their largest; Slovaks work on realization of the Pittsburgh Agreement.
6 – Bet Cet	1936	"Fastest human," Clevelander Jesse Owens, wins four gold medals in track at the 1936 Olympics in Berlin in the presence of Adolf Hitler. In 1935, Owens beat six world records in one hour.
5 – Bet Ari	1941	Racial integration begins in musical form – jazz.
4 – Gam Cep	1946	Hispanic-American settlers to arrive over the next 20 years. Legendary pitcher Leroy "Satchel" Paige will help Indians win World Series (1948). Last year, the great Cleveland Buckeye centerfielder, Sam Jethroe, was Negro American League's MVP.
3 – Alp Ps A	1963	Carl Stokes to be 1st African-American mayor of a major city (1967).
2 – Eta Cas	1975	Clevelanders appreciate the ethnic diversity offered by such neighborhoods as Little Italy and Slavic Village.
1 – Tau Cet	1984	Asian and Arab Americans move to Cleveland in larger numbers.

For
Aspiring Astronomers

January Sky Events

Sunrise/Sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
Jan. 1	7:53 a.m.	120.5°	5:07 p.m.	239.5°
Jan. 11	7:52 a.m.	119°	5:17 p.m.	241°
Jan. 21	7:48 a.m.	116°	5:28 p.m.	243°
Jan. 31	7: 40 a.m.	113°	5:40 p.m.	247°

Astronomical Twilight

	Morning twilight begins	Evening twilight ends
Jan. 1	6:13 a.m.	6:46 p.m.
Jan. 11	6:13 a.m.	6:55 p.m.
Jan. 21	6:11 a.m.	7:05 p.m.
Jan. 31	6:04 a.m.	7:16 p.m.

Moon Times

Date	Phase	Moonset	Azimuth	Moonrise	Azimuth
Jan. 5	Full	7:20 a.m.	294°	5:28 p.m.	66°
		Moonrise	**Azimuth**	**Moonset**	**Azimuth**
Jan. 13	LQ	12:14 a.m.	98.5°	11:44 a.m.	259°
Jan. 20	NM	7:30 a.m.	111°	6:06 p.m.	251°
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
Jan. 27	FQ	12:54 a.m.	285°	11:46 a.m.	72.5°

Selected Astronomical Events

Jan. 2	Mercury greatest eastern elongation
Jan. 4	Earth closest to sun this year, 2 a.m. EST, 91,400,000 miles (147,087,900 km)
Jan. 18	Moon near Jupiter this morning towards the east
Jan. 22	Moon near Venus this evening, look towards the SW
Jan. 23	Moon near Saturn this evening

*All times cited are EST. Add one hour for daylight savings.

February Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
Feb. 1	7:39 a.m.	112.5°	5:42 p.m.	248°
Feb. 11	7:28 a.m.	108°	5:55 p.m.	252°
Feb. 21	7:14 a.m.	103.5°	6:07 p.m.	256.5°
Feb. 29	7:02 a.m.	99.5°	6:17 p.m.	260.5°

Astronomical Twilight

	Morning Twilight Begins	Evening Twilight ends
Feb. 1	6:04 a.m.	7:17 p.m.
Feb. 11	5:54 a.m.	7:28 p.m.
Feb. 21	5:42 a.m.	7:39 p.m.
Feb. 29	5:30 a.m.	7:48 p.m.

Moon Times

Date	Phase	Moonset	Azimuth	Moonrise	Azimuth
Feb. 4	Full	7:13 a.m.	286°	6:09 p.m.	75°
		Moonrise	**Azimuth**	**Moonset**	**Azimuth**
Feb. 12	LQ	1:17 a.m.	111°	11:41 a.m.	247.5°
Feb. 18	NM	6:46 a.m.	103.5°	6:04 p.m.	256.5°
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
Feb. 26	FQ	1:34 a.m.	293°	11:43 a.m.	65.5°

Selected Astronomical Events:

Feb. 2	Venus near Saturn in SW after sunset
Feb. 15	Moon near Jupiter this morning in Sagittarius
Feb. 20	Moon near Saturn this evening
Feb. 21	Moon near Venus this evening after sunset, face SW

*All times cited are EST. Add one hour for daylight savings.

March Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
Mar. 1	7:01 a.m.	99°	6:18 p.m.	261°
Mar. 11	6:45 a.m.	94°	6:29 p.m.	266°
Mar. 21	6:28 a.m.	88.5°	6:40 p.m.	271.5°
Mar. 31	6:11 a.m.	83.5°	6:51 p.m.	277°

Astronomical Twilight

	Morning twilight begins	Evening twilight ends
Mar. 1	5:28 a.m.	7:49 p.m.
Mar. 11	5:12 a.m.	8:01 p.m.
Mar. 21	4:54 a.m.	8:13 p.m.
Mar. 31	4:35 a.m.	8:26 p.m.

Moon Times

Date	Phase	Moonset	Azimuth	Moonrise	Azimuth
Mar. 5	Full	6:48 a.m.	273.5°	6:58 p.m.	89°
		Moonrise	**Azimuth**	**Moonset**	**Azimuth**
Mar. 12	LQ	1:16 a.m.	115°	11:21 a.m.	245°
Mar.19	NM	6:30 a.m.	88.5°	7:11 p.m.	275°
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
Mar. 26	FQ	1:06 a.m.	294°	11:10 a.m.	65°

Selected Astronomical Events:

Mar. 14	Moon near Jupiter this morning in SE before sunrise
Mar. 20	Spring begins 3:04 EST
Mar. 22	Moon near Venus this evening
Mar. 31	Venus shines brilliantly in west after sunset

*All times cited are EST. Add one hour for daylight savings.

April Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
Apr. 1	6:09 a.m.	83°	6:52 p.m.	277°
Apr. 10	5:54 a.m.	78°	7:02 p.m.	282°
Apr. 20	5:39 a.m.	73.5°	7:13 p.m.	287°
Apr. 30	5:25 a.m.	69°	7:24 p.m.	291°

Astronomical Twilight

	Morning twilight begins	Evening twilight ends
Apr. 1	4:34 a.m.	8:28 p.m.
Apr. 10	4:16 a.m.	8:40 p.m.
Apr. 20	3:56 a.m.	8:55 p.m.
Apr. 30	3:37 a.m.	9:11 p.m.

Moon Times

Date	Phase	Moonset	Azimuth	Moonrise	Azimuth
Apr. 3	Full	5:50 a.m.	265°	6:50 p.m.	98°
		Moonrise	**Azimuth**	**Moonset**	**Azimuth**
Apr. 10	LQ	1:04 a.m.	114°	11:17 p.m.	247°
Apr. 17	NM	5:35 a.m.	79.5°	7:06 p.m.	283.5°
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
Apr. 25	FQ	1:07 a.m.	290°	11:39 a.m.	71°

Selected Astronomical Events:

Apr. 3	Total eclipse of Moon (rises 6:50 p.m.); eclipse in progress as Moon rises; Moon enters totality at 6:26 p.m. and leaves totality at 7:53 p.m. EST
Apr. 10	Moon near Jupiter this morning
Apr. 14	Mercury emerges from sun's glare and enters evening twilight for the rest of April; look for Mercury towards the west
Apr. 15	Moon near Saturn this morning towards the east
Apr. 21	Lyrid Meteor Shower, peak 11 p.m.; Moon near Venus this evening

*All times cited are EST. Add one hour for daylight savings.

May Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
May 1	5:23 a.m.	69°	7:25 p.m.	291.5°
May 11	5:11 a.m.	65°	7:35 p.m.	295.5°
May 21	5:02 a.m.	61.5°	7:45 p.m.	298.5°
May 31	4:56 a.m.	59°	7:54 p.m.	301°

Astronomical twilight

	Morning twilight begins	Evening twilight ends
May 1	3:36 a.m.	9:12 p.m.
May 11	3:18 a.m.	9:28 p.m.
May 21	3:03 a.m.	9:44 p.m.
May 31	2:51 a.m.	9:58 p.m.

Moon Times

Date	Phase	Moonset	Azimuth	Moonrise	Azimuth
May 3	Full	5:34 a.m.	252°	7:52 p.m.	110.5°
		Moonrise	**Azimuth**	**Moonset**	**Azimuth**
May 10	LQ	1:18 a.m.	104°	12:31 p.m.	258°
May 17	NM	5:25 a.m.	68°	7:55 p.m.	293°
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
May 25	FQ	12:47 a.m.	280°	12:18 p.m.	82°

Selected Astronomical Events:

May 5	Venus reaches greatest northern declination during the 20th century, +28° ; look north of west about 1 hour after sunset
May 7	Moon near Jupiter this morning
May 13	Moon near Saturn this morning
May 19	Moon near Venus this evening

*All times cited are EST. Add one hour for daylight savings.

June Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
June 1	4:55 a.m.	59°	7:54 p.m.	301°
June 10	4:52 a.m.	57.5°	8:00 p.m.	302.5°
June 20	4:53 a.m.	57°	8:04 p.m.	303°
June 30	4:56 a.m.	57.5°	8:04 p.m.	302.5°

Astronomical Twilight

	Morning twilight begins	Evening twilight ends
June 1	2:50 a.m.	9:59 p.m.
June 10	2:43 a.m.	10:09 p.m.
June 20	2:42 a.m.	10:14 p.m.
June 30	2:47 a.m.	10:13 p.m.

Moon Times

Date	Phase	Moonset	Azimuth	Moonrise	Azimuth
June 1	Full	4:56 a.m.	246°	7:45 p.m.	115°
		Moonrise	**Azimuth**	**Moonset**	**Azimuth**
June 8	LQ	12:33 a.m.	95°	12:37 p.m.	268°
June 15	NM	4:49 a.m.	65°	7:34 p.m.	295°
June 24	FQ	12:18 a.m.	267°	1:04 p.m.	95.5°
June 30	Full	4:33 a.m.	244°	7:29 p.m.	115°

Selected Astronomical Events:

June 4	Moon passes Jupiter this morning
June 9	Moon near Saturn this morning
June 13	Moon near planets Mercury and Mars this morning; look a little north of east about 5 a.m. EST
June 20	Summer begins at 9:25 p.m. EST
June 30	Venus enters morning twilight; it is close to Mars this morning; look azimuth 80° about 5 a.m. EST

*All times cited are EST. Add one hour for daylight savings.

July Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
July 1	4:57 a.m.	57.5°	8:04 p.m.	302.5°
July 11	5:03 a.m.	59°	8:01 p.m.	301°
July 21	5:11 a.m.	61.5°	7:54 p.m.	298.5°
July 31	5:21 a.m.	64.5°	7:45 p.m.	295.5°

Astronomical Twilight

	Morning twilight begins	Evening twilight ends
July 1	2:41 a.m.	10:12 p.m.
July 11	2:58 a.m.	10:05 p.m.
July 21	3:11 a.m.	9:53 p.m.
July 31	3:27 a.m.	9:37 p.m.

Moon Times

Date	Phase	Moonrise	Azimuth	Moonset	Azimuth
July 7	LQ			12:39 p.m.	277.5°
July 15	NM	5:16 a.m.	67°	7:43 p.m.	291°
July 23	FQ	12:56 p.m.	104°	11:56 p.m.	254°
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
July 30	Full	5:36 a.m.	251°	7:46 p.m.	106°

Selected Astronomical Events:

July 1	Moon near Jupiter this morning about 1 a.m. EST
July 4	Jupiter is opposite the sun in its orbit relative to the Earth; rises at sunset and is visible all night
July 5	Earth farthest from the sun during 1996, 2 p.m. EST; distance is 94,524,200 miles (152,098,800 km)
July 5	Venus can now be easily located in predawn skies
July 7	Moon near Saturn this morning
July 12	Moon near Venus this morning; look for Mars to their left
July 28	Moon near Jupiter this evening

*All times cited are EST. Add one hour for daylight savings.

August Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
Aug. 1	5:22 a.m.	65°	7:43 p.m.	295°
Aug. 11	5:32 a.m.	69°	7:31 p.m.	291°
Aug. 21	5:42 a.m.	73.5°	7:17 p.m.	286.5°
Aug. 31	5:52 a.m.	78°	7:01 p.m.	282°

Astronomical Twilight

	Morning twilight begins	Evening twilight ends
Aug. 1	3:28 a.m.	9:36 p.m.
Aug. 11	3:44 a.m.	9:18 p.m.
Aug. 21	3:59 a.m.	8:58 p.m.
Aug. 31	4:13 a.m.	8:39 p.m.

Moon Times

Date	Phase	Moonset	Azimuth	Moonrise	Azimuth
Aug. 6	LQ	1:36 p.m.	290°		
		Moonrise	**Azimuth**	**Moonset**	**Azimuth**
Aug. 14	NM	5:56 a.m.	76°	7:26 p.m.	281°
Aug. 21	FQ	12:51 p.m.	110.5°	11:17 p.m.	248°
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
Aug. 28	Full	5:37 a.m.	259°	6:58 p.m.	98°

Selected Astronomical Events:

Aug. 3	Moon near Saturn this morning
Aug. 10	Moon near Venus and Mars this morning
Aug. 11	Perseids Meteor Shower, watch throughout the night
Aug. 20	Venus reaches greatest distance west of sun during 1996
Aug. 24	Moon near Jupiter this evening
Aug. 30	Moon near Saturn this morning

*All times cited are EST. Add one hour for daylight savings.

September Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
Sept. 1	5:53 a.m.	78.5°	6:59 p.m.	281.5°
Sept. 10	6:02 a.m.	83°	6:44 p.m.	277°
Sept. 20	6:12 a.m.	88.5°	6:27 p.m.	271.5°
Sept. 30	6:23 a.m.	93.5°	6:09 p.m.	266.5°

Astronomical Twilight

	Morning twilight begins	Evening twilight ends
Sept. 1	4:15 a.m.	8:36 p.m.
Sept. 10	4:26 a.m.	8:18 p.m.
Sept. 20	4:38 a.m.	7:59 p.m.
Sept. 30	4:50 a.m.	7:41 p.m.

Moon Times

Date	Phase	Moonset	Azimuth	Moonrise	Azimuth
Sept. 4	LQ	1:20 p.m.	294°	11:29 p.m.	66°
		Moonrise	**Azimuth**	**Moonset**	**Azimuth**
Sept. 12	NM	5:44 a.m.	84°	6:28 p.m.	273°
Sept. 20	FQ	1:44 p.m.	115°	11:51 p.m.	245.5°
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
Sept. 26	Full	5:38 a.m.	268°	6:05 p.m.	88.5°

Selected Astronomical Events:

Sept. 4	Venus near Mars this morning; look towards east one hour before sunrise
Sept. 8	Moon near Venus and Mars this morning
Sept. 20	Moon near Jupiter this evening
Sept. 22	Fall begins 1:01 p.m. EST
Sept. 26	Total Eclipse of Moon; enters totality at 9:19 p.m. EST and leaves totality at 10:29 p.m. EST

*All times cited are EST. Add one hour for daylight savings.

October Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
Oct. 1	6:24 a.m.	94°	6:08 p.m.	266°
Oct. 11	6:35 a.m.	99°	5:51 p.m.	261°
Oct. 21	6:46 a.m.	104°	5:36 p.m.	256°
Oct. 31	6:58 a.m.	108.5°	5:22 p.m.	251.5°

Astronomical Twilight

	Morning twilight begins	Evening twilight ends
Oct. 1	4:51 a.m.	7:40 p.m.
Oct. 11	5:02 a.m.	7:23 p.m.
Oct. 21	5:13 a.m.	7:08 p.m.
Oct. 31	5:24 a.m.	6:46 p.m.

Moon Times

Date	Phase	Moonset	Azimuth	Moonrise	Azimuth
Oct. 4	LQ	1:37 p.m.	293°		
		Moonrise	**Azimuth**	**Moonset**	**Azimuth**
Oct. 12	NM	6:32 a.m.	98.5°	6:02 p.m.	259°
Oct. 19	FQ	1:23 p.m.	111.5°	11:52 p.m.	250°
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
Oct. 26	Full	6:44 a.m.	283°	5:50 p.m.	74°

Selected Astronomical Events:

Oct. 3	Mercury reaches greatest western point in its orbit as viewed from Earth. It is at its morning best; look azimuth 94°, altitude 11.7° at 6 a.m. EST; higher up, you will see Venus and Mars
Oct. 7	Moon near Mars this morning
Oct. 8	Moon near Venus this morning
Oct. 18	Moon near Jupiter this evening
Oct. 21	Orionid Meteor Shower peaks this evening about midnight
Oct. 23	Moon near Saturn this evening

*All times cited are EST. Add one hour for daylight savings.

November Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
Nov. 1	6:59 a.m.	109°	5:21 p.m.	251°
Nov. 10	7:10 a.m.	112.5°	5:11 p.m.	247.5°
Nov. 20	7:22 a.m.	116°	5:03 p.m.	244°
Nov. 30	7:33 a.m.	119°	4:58 p.m.	241°

Astronomical Twilight

	Morning twilight begins	Evening twilight begins
Nov. 1	5:25 a.m.	6:54 p.m.
Nov. 10	5:34 a.m.	6:46 p.m.
Nov. 20	5:45 a.m.	6:39 p.m.
Nov. 30	5:54 a.m.	6:36 p.m.

Moon Times

Date	Phase	Moonset	Azimuth	Moonrise	Azimuth
Nov. 3	LQ	1:27 p.m.	286°		
		Moonrise	**Azimuth**	**Moonset**	**Azimuth**
Nov. 10	NM	6:24 a.m.	106°	5:12 p.m.	252°
Nov. 17	FQ	12:50 p.m.	105°		
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
Nov. 24	Full	6:37 a.m.	290°	5:06 p.m.	68°

Selected Astronomical Events:

Nov. 5	Moon near Mars this morning
Nov. 8	Moon near Venus this morning
Nov. 14	Moon near Jupiter this evening
Nov. 17	Leonid Meteor Shower peaks this morning at 7 a.m.; observe after 3 a.m.
Nov. 20	Moon near Saturn this evening

*All times cited are EST. Add one hour for daylight savings.

December Sky Events

Sunrise/sunset

Date	Sunrise	Azimuth	Sunset	Azimuth
Dec. 1	7:34 a.m.	119°	4:58 p.m.	241°
Dec. 11	7:43 a.m.	120.5°	4:57 p.m.	239.5°
Dec. 21	7:50 a.m.	121°	5:00 p.m.	239°
Dec. 31	7:53 a.m.	121°	5:07 p.m.	239°

Astronomical Twilight

	Morning twilight begins	Evening twilight ends
Dec. 1	5:55 a.m.	6:36 p.m.
Dec. 11	6:03 a.m.	6:36 p.m.
Dec. 21	6:09 a.m.	6: 40 p.m.
Dec. 31	6:13 a.m.	6:46 p.m.

Moon Times

Date	Phase	Moonrise	Azimuth	Moonset	Azimuth
Dec. 3	LQ	12:07 a.m.	83°	12:59 p.m.	274°
Dec. 10	NM	7:18 a.m.	114.5°	5:25 p.m.	245°
		Moonset	**Azimuth**	**Moonrise**	**Azimuth**
Dec. 17	FQ	12:09 a.m.	267.5°	12:40 p.m.	89.5°
Dec. 24	Full	7:17 a.m.	295°	5:22 p.m.	65°

Selected Astronomical Events:

Dec. 3	Moon near Mars this morning
Dec. 12	Moon near Jupiter this evening
Dec. 13	Geminids Meteor Shower peaks this evening at 7 p.m.
Dec. 17	Moon near Saturn this evening
Dec. 21	Winter begins at 9:07 a.m. EST
Dec. 22	Ursids Meteor Shower peaks this morning at 1 a.m.

*All times cited are EST. Add one hour for daylight savings.

Table 1 – Magnitude of Selected Stars

STAR NAME	MAGNITUDE	CONSTELLATION
Sirius	-1.5	Canis Major
Arcturus	0.0	Bootes
Vega	0.0	Lyra
Capella	0.1	Auriga
Rigel	0.1	Orion
Procyon	0.4	Canis Minor
Betelgeuse	0.5	Orion
Altair	0.8	Aquila
Aldebaran	0.9	Taurus
Spica	1.0	Virgo
Antares	1.0	Scorpius
Pollux	1.1	Gemini
Regulus	1.4	Leo
Adhara	1.5	Canis Major
Castor	1.6	Gemini
El Nath	1.7	Taurus
Alioth	1.8	Ursa Major
Dubhe	1.8	Ursa Major
Alkaid	1.9	Ursa Major
Polaris	2.0	Ursa Minor

Declin.	East				Meridian	West			
	-4 Az/Alt	-3 Az/Alt	-2 Az/Alt	-1 Az/Alt	Az/Alt	+1 Az/Alt	+2 Az/Alt	+3 Az/Alt	+4 Az/Alt
-30	132/0	142/7	153.5/13	166.5/17	180/18.5	193.5/17	206.5/13	218/7	228/0
-24	127.5/4	138.5/12.5	151/15	165/23	180/24.5	195/23	209/15	221.5/12.5	232.5/4
-18	123.5/9	135/17.5	148.5/24.5	163.5/29	180/30.5	196.5/29	211.5/24.5	225/17.5	236.5/9
-12	119.5/13	131.5/22.5	146/30	162/35	180/36.5	198/35	214/30	228.5/22.5	240.5/13
-6	115.5/17.5	128/27	142.5/35	160/40.5	180/42.5	200/40.5	217.5/35	232/27	244.5/17.5
0	111/22	123.5/32	139/40.5	158/46	180/48.5	202/46	221/40.5	236.5/32	249/22
+6	106/26	119/36.5	135/45.5	155/52	180/54.5	205/52	225/45.5	241/36.5	254/26
+12	101/30	113.5/41	129.5/50.5	152/58	180/60.5	208/58	230.5/50.5	246.5/41	259/30
+18	96/34	107.5/45	123.5/55	147/63	180/66.5	213/63	236.5/55	252.5/45	264/34
+24	90/38	101/48	116/59.5	140/68.5	180/71.5	220/68.5	244/59.5	259/49	270/38
+30	83.5/41	93/52	106/63	128.5/73	180/78.5	231/73	254/63	267/52	276.5/41
+36	76/44	84/55	93.5/77	110/77	180/84.5	250/77	266.5/66	276/55	284/44
+42	58.5/46	74/57	78.5/68	82.5/79	360/89.5	277.5/79	281.5/68	286/57	291.5/46
+48	60/48	63/58	63/68	53.5/73.5	360/83.5	306/77.5	297/68	297/58	300/48
+54	51/49	51.5/58	37.5/66.5	33.5/74	360/77.5	326/74	312.5/66.5	308.5/58	309/49
+60	42/49.5	40.5/57	34.5/64	21.5/69	360/71.5	338.5/69	325.5/64	319.5/57	318/49.5
+66	33/49	30/55	24/60.5	14/64	360/65.5	346/64	336/60.5	330/55	327/49
+72	24/48	21/52.5	16/56	9/58.5	360/59.5	351/58.5	344/56	339/52.5	336/48
+78	15/46.5	13/49	9.5/51.5	5/53	360/53.5	355/53	350.5/51.5	347/49	345/46.5
+84	7/44	6/45.5	4.5/46.5	2/47	360/47.5	358/47	355.5/46.5	354/45.5	353/44

Table 2 – Azimuths and altitudes of stars up to four hours east and west of meridian

Table 3 – Star Time 8 p.m. EST

Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	2:17	4:19	6:13	8:16	10:13	12:16	14:15	16:16	18:19	20:19	22:19	0:17
3	2:25	4:27	6:21	8:23	10:22	12:24	14:22	16:25	18:27	20:25	22:27	0:24
5	2:34	4:34	6:29	8:31	10:30	12:32	14:30	16:33	18:35	20:33	22:35	0:33
7	2:40	4:42	6:37	8:39	10:38	12:40	14:38	16:40	18:43	20:41	22:43	0:41
9	2:48	4:50	6:44	8:47	10:45	12:47	14:46	16:48	18:50	20:48	22:51	0:49
11	2:57	4:58	6:52	8:55	10:53	12:56	14:54	16:56	18:58	20:56	22:58	0:57
13	3:04	5:06	7:01	9:03	11:01	13:04	15:02	17:04	19:06	21:04	23:06	1:05
15	3:12	5:14	7:09	9:11	11:09	13:11	15:10	17:12	19:14	21:12	23:15	1:13
17	3:21	5:22	7:16	9:19	11:17	13:19	15:17	17:20	19:22	21:20	23:22	1:21
19	3:28	5:30	7:25	9:26	11:25	13:27	15:25	17:28	19:30	21:28	23:30	1:28
21	3:36	5:38	7:32	9:26	11:33	13:35	15:33	17:36	19:38	21:36	23:38	1:36
23	3:44	5:410	7:40	9:42	11:41	13:43	15:41	17:43	19:45	21:44	23:46	1:44
25	3:51	5:54	7:48	9:50	11:49	13:51	15:49	17:52	19:53	21:52	23:54	1:52
27	4:00	6:02	7:56	9:50	11:56	13:58	15:57	17:59	20:01	22:00	0:02	2:00
29	4:07	6:10	8:04	10:06	12:04	14:07	16:05	18:07	20:09	22:08	0:10	2:08
31	4:15		8:12		12:12		16:13	18:15		22:15		2:16

Table 4 –The Greek Alphabet

Greek Letter	Greek Name	English Equivalent
Α α	Alpha (Alp)	a
Β β	Beta (Bet)	b
Γ γ	Gamma (Gam)	g
Δ δ	Delta (Del)	d
Ε ε	Epsilon (Eps)	e
Ζ ζ	Zeta (Zet)	z
Η η	Eta	e
Θ θ ϑ	Theta (The)	th
Ι ι	Iota (Iot)	i
Κ κ	Kappa (Kap)	k
Λ λ	Lambda (Lam)	l
Μ μ	Mu	m
Ν ν	Nu	n
Ξ ξ	Xi	x
Ο ο	Omicron (Omi)	o
Π π	Pi	p
Ρ ρ	Rho	r
Σ σ ς	Sigma (Sig)	s
Τ τ	Tau	t
Υ υ	Upsilon	u
Φ ϕ φ	Phi	ph
Χ χ	Chi	ch
Ψ ψ	Psi	ps
Ω ω	Omega (Ome)	o

Table 5 – The 88 Constellations Visible from Earth

Antlia (Ant) – Air Pump
Andromeda (And) – Princess of Ethiopia
Aquarius (Aqr) – Water Bearer
Aquila (Aql) – Eagle
Ara, (Ara) *in part* – Altar
Aries (Ari) – Ram
Apus (Aps) – Bird of Paradise
Auriga (Aur) – Charioteer

Bootes (Boo) – Herdsman

Caelum, (Cae) *in part* – Graving Tool
Camelopardalis (Cam) – Giraffe
Cancer (Cnc) – Crab
Canes Venatici (CVn) – Hunting Dogs
Canis Major (CMa) – Large Dog
Canis Minor (CMi) – Small Dog
Capricornus (Cap) – Sea Goat
Cassiopeia (Cas) – Queen of Ethiopia
Carina (Car) – Keel
Centaurus, (Cen) *in part* – Centaur
Cepheus (Cep) – King of Ethiopia
Cetus (Cet) – Sea Monster, whale
Chamaeleon (Cha) – Chamaeleon
Circinus (Cir) – Compass
Columba (Col) – Dove
Coma Berenices (Com) – Berenice's Hair
Corvus (Crv) – Crow
Corona Austrinus (CrA) – S. Crown
Corona Borealis (CrB) N. Crown
Crater (Crt) – Cup
Crux (Cru) – Southern Cross
Cygnus (Cyg) – Swan

Draco (Dra) – Dragon
Delphinus (Del) – Porpoise or Dolphin)
Dorado (Dor) – Goldfish

Equuleus (Equ) – Little Horse
Eridanus (Eri) – River

Fornax (For) – Furnace

Gemini (Gem) – Twins
Grus, (Gru) *in part* – Crane

Hercules (Her) – Hercules
Horologium, (Hor) *in part* – Clock
Hydra (Hya) – Sea Serpent
Hydrus (Hyi) – Water Serpent

Indus, (Ind) *in part* – Indian

Lacerta (Lac) – Lizard
Leo (Leo) – Lion
Leo Minor (LMi) – Little Lion
Lepus (Lep) – Hare
Libra (Lib) – Balance
Lupus, *(Lup) in part* – Wolf
Lynx (Lyn) – Lynx
Lyra (Lyr) – Lyre

Mensa (Men) – Table Mountain
Microscopium (Mic) – Microscope
Monoceros (Mon) – Unicorn
Musca (Mus) – Fly

Norma, (Nor) *in part* – Carpenter's Level

Octans (Oct) – Octant
Ophiuchus (Oph) – Holder of the Serpent
Orion (Ori) – Hunter
Pavo (Pav) – Peacock
Pegasus (Peg) – Winged Horse
Perseus (Per) – Perseus
Phoenix, (Phe) *in part* – Firebird
Pictor, (Pic) *in part* – Easel
Pisces (Psc) – Fishes
Pisces Austrinus (PsA) – Southern Fish
Puppis, (Pup) *in part* – Stern of the Argonauts' Ship
Pyxis, (Pyx) *in part* Compass on the Argonauts' Ship

Reticulum (Ret) – Net

Sagitta (Sge) – Arrow
Sagittarius (Sgr) – Archer
Scorpius (Sco) – Scorpion
Scutum (Sct) – Sculptor's Tools
Serpens (Ser) – Serpent's Head
Sextans (Sex) – Sextant

Taurus (Tau) – Bull
Telescopium, (Tel) *in part* – Telescope
Triangulum (Tri) – Triangle
Triangulum Australe (TrA) – Southern Triangle
Tucana (Tuc) – Toucan

Ursa Major (UMa) – Big Bear
Ursa Minor (UMi) – Little Bear

Vela, (Vel) *in Part* – Sail of the Argonauts' Ship
Virgo (Vir) – Virgin
Volans (Vol) – Flying Fish
Vulpecula – Fox

Table 6 – A

Name	Position				Distance	M_v
	Right Ascension		Declination		(Light Yrs)	(Visible Magnitude)
Alp Cen	14 h	39'	-60°	49'	4	0
Sirius	6 h	45'	-16°	43'	9	-1.5
Procyon	7 h	39'	+5°	14'	11	0.4
Tau Cet	1 h	44'	-15°	58'	12	3.5
Altair	19 h	51'	+8°	51'	16	0.8
Eta Cas	0 h	49'	+57°	48'	19	3.4
Alp PsA	22 h	57'	-29°	37'	21	1.2
Xi UMa	11 h	18'	+31°	35'	24	4.4
Vega	18 h	37'	+38°	47'	25	0
Gam Lep	5 h	44'	-22°	27'	26	3.6
Pi3 Ori	4 h	50'	+6°	57'	27	3.2
Bet CVn	12 h	34'	+41°	23'	28	4.3
Del Eri	3 h	42'	-9°	47'	31	3.5
Zet Her	16 h	41'	+31°	37'	32	2.8
Gam Vir	12 h	41'	-1°	25'	33	3.7
Bet Gem	7 h	45'	+28°	02'	34	1.1
Bet Vir	11 h	50'	+1°	47'	35	3.6
Eta Boo	13 h	54'	+18°	25'	36	2.7
Arcturus	14 h	15'	+19°	12'	37	0
Iot Peg	22 h	06'	+25°	19'	38	3.8
Gam Ser	15 h	56'	+15°	41'	39	3.9
Bet Leo	11 h	49'	+14°	36'	40	2.1
Capella	5 h	14'	+46°	00'	41	0.1
Eta Lep	5 h	56'	-14°	10'	42	3.7
Bet Aql	19 h	55'	+6°	24'	43	3.7
Del Aql	19 h	25'	+3°	06'	44	3.4
Iot Psc	23 h	40'	+5°	36'	45	4.1
Iot UMa	8 h	59'	+48°	04'	46	3.1
Castor	7 h	34'	+31°	54'	47	1.6
Del Cap	21 h	47'	-16°	09'	48	2.9
Alp Cep	21 h	18'	+62°	14'	49	2.4
Gam Cep	23 h	39'	+77°	36'	50	3.2
Alp Oph	17 h	35'	+12°	34'	51	2.1
Del Gem	7 h	20'	+21°	59'	52	3.5
Lam Sgr	18 h	28'	-25°	25'	53	2.8
Iot Cen	13 h	20'	-36°	41'	54	2.8
Bet Ari	1 h	54'	+20°	47'	55	2.6
The Cen	14 h	06'	-36°	21'	56	2.1

Table 6 – B

Name	Position				Distance	M_v
	Right Ascension		Declination		(Light Yrs)	(Visible Magnitude)
Eta Sco	17 h	12'	-43°	14'	57	3.3
Del UMa	12 h	15'	+57°	03'	58	3.3
Psi Dra	17 h	41'	+72°	09'	59	4.6
Bet Cet	0 h	43'	-18°	01'	60	2.0
Alp Lib	14 h	51'	-16°	01'	61	2.8
Eta Ser	18 h	21'	-2°	54'	62	3.3
Eta Oph	17 h	10'	-15°	43'	63	2.4
Xi Gem	6 h	45'	+12°	54'	64	3.4
Alp Ari	2 h	07'	+22°	26'	65	2.0
Bet Eri	5 h	08'	-5°	06'	66	2.8
Bet And	1 h	09'	+35°	36'	67	2.1
Aldebaran	4 h	36'	+16°	30'	68	0.9
Gam Cet	2 h	43'	+3°	13'	69	3.5
Eta Dra	16 h	24'	+61°	31'	70	2.7
Del Leo	11 h	14'	+20°	33'	71	2.6
Alp Ser	15 h	44'	+6°	36'	72	2.7
Gam Aqr	22 h	21'	-1°	25'	73	3.8
Bet Aur	5 h	59'	+44°	57'	74	1.9
Alp CrB	15 h	34'	+26°	44'	75	2.2
Tau Sgr	19 h	07'	-27°	41'	76	3.3
Lam Peg	22 h	46'	+23°	33'	77	4.0
Zet Aql	19 h	05'	+13°	51'	78	3.0
Zet UMa	13 h	24'	+54°	57'	79	2.3
Eta Cet	1h		-10		80	3.5
Alp Cap	20 h	17'	-12°	31'	81	3.6
Del Her	17 h	15'	+24°	51'	82	3.1
Bet Oph	17 h	43'	+4°	34'	83	2.8
Eps Ser	15 h	51'	+4°	29'	84	3.7
Iot Dra	15 h	25'	+58°	59'	85	3.3
Gam Tri	2 h	17'	+33°	50'	86	4.0
Regulus	10 h	08'	+11°	59'	87	1.4
Del Aqr	22 h	54'	-15°	51'	88	3.2
Bet Ser	15 h	46'	+15°	26'	89	3.7
The1 Tau	4 h	28'	+15°	57'	90	3.8
Algol	3 h	08'	+40°	56'	91	2.1
Alp Peg	23 h	05'	+15°	11'	92	2.5
Pi2 Ori	4 h	50'	+8°	54'	93	4.4
Bet Crv	12 h	34'	-23°	22'	94	2.7

Table 6 – C

Name	Position				Distance	M_v
	Right Ascension		Declination		(Light Yrs)	(Visible Magnitude)
Gam Oph	17 h	48'	+2°	43'	95	3.8
Iot Leo	11 h	24'	+10°	33'	96	3.9
Bet Del	20 h	37'	+14°	35'	97	3.6
Zet Hya	8 h	55'	+5°	58'	98	3.1
Eta UMa	13 h	47'	+49°	20'	99	1.9
Mu UMa	10 h	22'	+41°	31'	100	3.1
Eps Vir	13 h	02'	+10°	59'	101	2.8
Xi Ser	17 h	37'	-15°	23'	102	3.5
Eta Her	16 h	43'	+38°	56'	103	3.5
Kap Per	3 h	09'	+44°	50'	104	3.8
Eps Sco	16 h	50'	-34°	17'	105	2.3
Gam Psc	23 h	17'	+3°	15'	106	3.7
Xi Dra	17 h	53'	+56°	52'	107	3.8
Bet Col	5 h	51'	-35°	46'	108	3.1
Kap Oph	16 h	57'	+9°	23'	109	3.2
Nu Tau	4 h	03'	+5°	59'	110	3.9
Lam UMa	10 h	17'	+42°	56'	111	3.5
Nu Hya	10 h	49'	-16°	10'	112	3.1
Bet Boo	15 h	02'	+40°	24'	113	3.5
Del Oph	16 h	14'	-3°	41'	114	2.7
Del And	0 h	39'	+30°	50'	115	3.3
Del Cas	1 h	26'	+60°	13'	116	2.7
Bet CrB	15 h	28'	+29°	07'	117	3.7
Alp And	0 h	08'	+29°	03'	118	2.1
Eps Psc	1 h	03'	+7°	52'	119	4.3
The2 Tau	4 h	28'	+15°	52'	120	3.4
Alp UMa	11 h	43'	+61°	47'	121	1.8
The Sco	17 h	37'	-43°	00'	122	1.9
Zet Lyr	18 h	45'	+37°	36'	123	4.4
Gam Tau	4 h	20'	+15°	37'	124	3.7
Iot Cep	22 h	50'	+66°	11'	125	3.5
Gam Del	20 h	46'	+16°	06'	126	4.3
Omi Cet	2 h	19'	-3°	00'	127	3.0
Gam Ari	1 h	54'	+18°	15'	128	4.8
Bet Tau	5 h	26'	+28°	36'	129	1.7
Gam Sgr	18 h	06'	-30°	25'	130	3.0
Zet Dra	17 h	09'	+65°	43'	131	3.2
Zet Cyg	21 h	13'	+30°	13'	132	3.2

Table 6 – D

Name	Position				Distance (Light Yrs)	M_v (Visible Magnitude)
	Right Ascension		Declination			
Del Crv	12 h	30'	-16°	29'	133	3.0
Zet Peg	22 h	41'	+10°	48'	134	3.4
Iot Gem	7 h	25'	+27°	48'	135	3.8
Kap Gem	7 h	4 4'	+24°	25'	136	3.6
Bet UMi	14 h	51'	+74°	10'	137	2.1
Alp CVn	12 h	56'	+38°	21'	138	2.9
Kap Vir	14 h	13'	-10°	15'	139	4.2
Zet Aqr	22 h	29'	-0°	03'	140	4.4
Gam Dra	17 h	57'	+51°	29'	141	2.2
Alp Vir	13 h	25'	-11°	08'	142	1.0
Nu Sco	16 h	12'	-19°	27'	143	4.0
Eps Crv	12 h	10'	-22°	36'	144	3.0
Antares	16 h	29'	-26°	25'	145	1.0
Bet CMi	7 h	27'	+8°	18'	146	2.9
Sig CMa	7 h	02'	-27°	56'	147	3.5
Alp Cnc	8 h	58'	+11°	53'	148	4.3
Eps Sgr	18 h	24'	-34°	23'	149	1.9
Gam Leo	10 h	20'	+19°	52'	150	2.6
Del Lep	5 h	51'	-20°	53'	151	3.8
The Aqr	22 h	17'	-7°	48'	152	4.2
Tau Psc	1 h	11'	+30°	04'	153	4.5
Mu Lep	5 h	13'	-16°	13'	154	3.3
The Leo	11 h	14'	+15°	27'	155	3.3
Del Vir	12 h	55'	+3°	25'	156	3.4
The Gem	6 h	52'	+33°	58'	157	3.6
Alp Lyn	9 h	21'	+34°	23'	158	3.1
Eps Del	20 h	33'	+11°	17'	159	4.0
Del Aur	5 h	59'	+54°	17'	160	3.7
Alp Mon	7 h	41'	-9°	32'	161	3.9
Bet CMa	6 h	23'	-17°	57'	162	2.0
Gam Her	16 h	22'	+19°	10'	163	3.8
Eps Aqr	20 h	47'	-9°	31'	164	3.8
Tau Sco	16 h	36'	-28°	12'	165	2.8
51 And	1 h	38'	+48°	36'	166	3.6
Tau Per	2 h	54'	+52°	45'	167	4.0
Sig Lib	15 h	04'	-25°	16'	168	3.3
Xi Her	17 h	58'	+29°	15'	169	3.7
Electra	3 h	44'	+23°	59'	170	3.7

Table 6 – E

Name	Position				Distance	M_v
	Right Ascension		Declination		(Light Yrs)	(Visible Magnitude)
Del1 Tau	4 h	23'	+17°	32'	171	3.8
Iot Sco	17 h	47'	-40°	08'	172	3.0
Del Sgr	18 h	21'	-29°	50'	173	2.7
Sig Pup	7 h	29'	-43°	18'	174	3.3
Del Mon	7 h	12'	-0°	29'	175	4.2
Nu Oph	17 h	59'	-9°	46'	176	3.3
Del Psc	0 h	48'	+7°	34'	177	4.4
Iot Aur	4 h	57'	+33°	10'	178	2.7
Bet Peg	23 h	04'	+28°	04'	179	2.4
Ome Psc	23 h	59'	+6°	50'	180	4.0
Gam Lyr	18 h	59'	+32°	41'	181	3.2
Eta Aur	5 h	06'	+41°	14'	182	3.2
Mu Hya	10 h	26'	-16°	49'	183	3.8
Gam Cas	0 h	56'	+60°	42'	184	2.5
Gam UMa	11 h	54'	+53°	43'	185	2.4
Bet Tri	2 h	09'	+34°	58'	186	3.0
Omi Ori	4 h	56'	+13*	30'	187	4.1
Del Col	6 h	22'	-33°	26'	188	3.9
Eta Aqr	22 h	35'	-0°	08'	189	4.0
Del2 Tau	4 h	23'	+16°	46'	190	4.8
Nu Aqr	21 h	09'	-11°	23'	191	4.5
Del Ser	15 h	35'	+10°	33'	192	3.8
48 Per	4 h	08'	+47°	42'	193	4.0
Nu UMa	11 h	18'	+33°	07'	194	3.5
Pi6 Ori	4 h	58'	+1°	42'	195	4.5
Eps Lyr	18 h	45'	+39°	41'	196	5.1
Ups Psc	1 h	19'	+27°	14'	197	4.7
Chi UMa	11 h	46'	+47°	48'	198	3.7
Zet Cep	22 h	11'	+58°	11'	199	3.4
Mu Gem	6 h	23'	+22°	31'	200	2.9

Table 7 – Time between rising and setting and transit of meridian for different declinations and azimuth of rising and setting points for Cleveland

Declination	Time between rising or setting and transit of meridian and Azimuth of rising and setting		
		Azimuth	
	Time	Rising°	Setting°
-30	3 hrs. 58 mins.	132°	228°
-25	4 hrs. 22 mins.	124.5°	235.5°
-20	4 hrs. 45 mins.	117°	243°
-15	5 hrs. 5 mins.	110°	250°
-10	5 hrs. 24 mins.	103.5°	256.5°
- 5	5 hrs. 42 mins.	97°	263°
0	6 hrs.	90°	270°
5	6 hrs. 18 mins.	83°	277°
10	6 hrs 36 mins.	76.5°	282.5°
15	6 hrs. 55 mins.	70°	290°
20	7 hrs. 15 mins.	63°	297°
25	7 hrs. 38 mins.	55.5°	304.5°
30	8 hrs. 2 mins.	48°	312°
35	8 hrs. 33 mins.	40°	320°
40	9 hrs. 10 mins.	31°	329°
45	10 hrs. 9 mins.	19°	341°
48	11 hrs. 17 mins.	7°	353°
48.5	12 hrs. (circumpolar)		

Table 8 – Monthly star map to use, according to time and date

Date	P.M. 6	7	8	9	10	11	Time mid.	A.M. 1	2	3	4	5	6
	Monthly Star Map												
1/1	Dec		Jan		Feb		Mar		Apr		May		June
1/15		Jan		Feb		Mar		Apr		May		June	
2/1	Jan		Feb		Mar		Apr		May		June		July
2/15		Feb		Mar		Apr		May		June		July	
3/1	Feb		Mar		Apr		May		June		July		Aug
3/15		Mar		Apr		May		June		July		Aug	
4/1	Mar		Apr		May		June		July		Aug		Sept
4/15		Apr		May		June		July		Aug		Sept	
5/1	Apr		May		June		July		Aug		Sept		Oct
5/15		May		June		July		Aug		Sept		Oct	
6/1	May		June		July		Aug		Sept		Oct		Nov
6/15		June		July		Aug		Sept		Oct		Nov	
7/1	June		July		Aug		Sept		Oct		Nov		Dec
7/15		July		Aug		Sept		Oct		Nov		Dec	
8/1	July		Aug		Sept		Oct		Nov		Dec		Jan
8/15		Aug		Sept		Oct		Nov		Dec		Jan	
9/1	Aug		Sept		Oct		Nov		Dec		Jan		Feb
9/15		Sept		Oct		Nov		Dec		Jan		Feb	
10/1	Sept		Oct		Nov		Dec		Jan		Feb		Mar
10/15		Oct		Nov		Dec		Jan		Feb		Mar	
11/1	Oct		Nov		Dec		Jan		Feb		Mar		Apr
11/15		Nov		Dec		Jan		Feb		Mar		Apr	
12/1	Nov		Dec		Jan		Feb		Mar		Apr		May
12/15		Dec		Jan		Feb		Mar		Apr		May	

Sun across the sky

Look at the diagram on the facing page, which shows the Sun's motion across the sky for March 20 and December 21, 1996. The azimuth is given on the horizontal line with 90° being directly in the east, 135° SE, 160° south, 225° southwest and 270° west. Altitude can be determined from the degrees on the meridian.

As you can see in the diagram, on March 20, the beginning of spring, the Sun will rise at 90° azimuth and at 12:34 p.m. will reach its highest point across the sky that day, when it is on the meridian with an altitude of 48.5°.

On December 21, the beginning of winter in 1996, the Sun will rise at an azimuth of 121° and will be only 25° above the horizon on the meridian at 12:25 p.m. True noon for us occurs at the moment that the Sun arrives on the meridian.

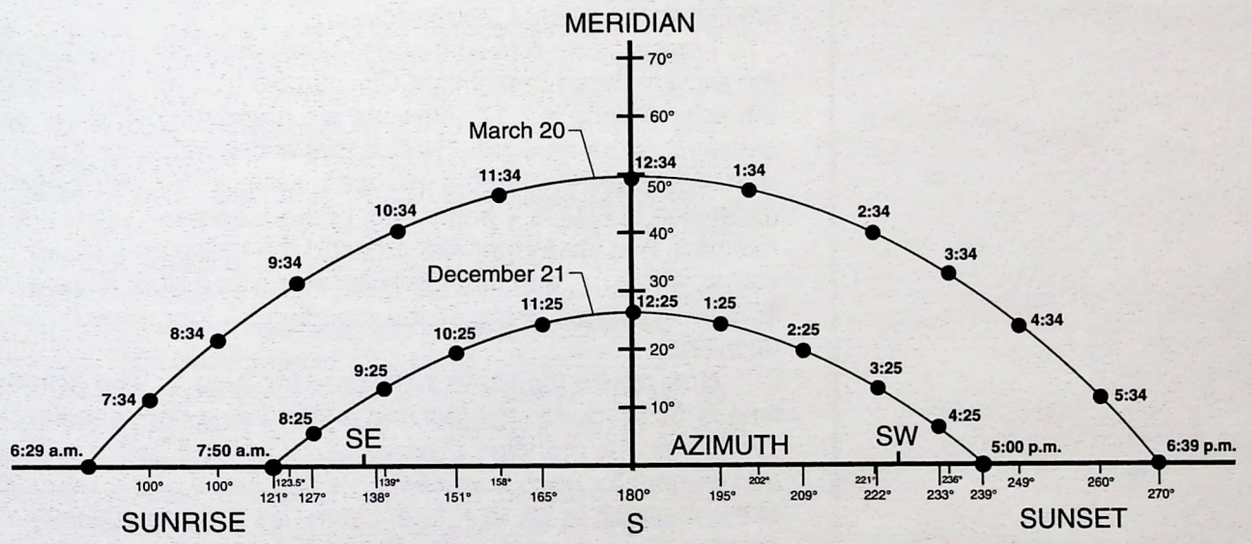
Remember declination corresponds to a celestial object's latitude. An object's declination will affect where an object rises and sets and how long it will take to cross the sky for us.

The diagram on the next page details the time between rising and setting and the transit of the meridian for different declinations. At the beginning of spring and fall, the Sun has declination of 0°. Refer to the table to find the information for an object with a declination of 0°. As can be seen from sunrise, it takes six hours to reach the meridian. Likewise from the meridian to sunset, the Sun takes an additional six hours. Therefore, the Sun is above the horizon for 12 hours. It can also be noted that the sun rises at an azimuth of 90° and sets at an azimuth of 270°.

For December 21, the sun has a declination of -23.5°. This number falls between -20° and -25°. From Cleveland, it can be seen that -23.5° is .7 of the difference between -20° and -25°. Therefore, by multiplying .7 x 23 min = 16.1 minutes (or 16 minutes rounded off). Sixteen minutes must be subtracted from four hours and 45 minutes, equalling 4 hours and 29 minutes. So our calculations enable us to say that on December 21, it will take the Sun 4 hours and 29 minutes from the time of rising to reach the meridian. Likewise, from crossing the meridian, it will take another 4 hours and 29 minutes for sunset to occur. So on December 21, the sun is on the horizon almost 9 hours.

It can be seen from the table that an object with a declination of 0° will always rise in the east, set in the west and be above the horizon for 12 hours. Likewise for a celestial object with a + declination will rise to the north of east and set to the north of west and be above the horizon for more than 12 hours.

Sun across the sky, as shown for two dates in Cleveland – March 20 and December 21, 1996



A more complete way to find the stars

Practice doing the following:

1. Determine the sidereal time for the time of your observations. The sidereal times are given in Table 3. For January 1 at 8 p.m., the sidereal time is 2:17.

2. Determine the right ascension and declination for the star for which you wish to observe from the information included for a given Monthly Star Chart.

3. Determine if the star is east or west of the meridian. The right ascension number gets larger east of the meridian and smaller to the west of the meridian.

Look at Table 6 (a-e) that describes the right ascension of the stars featured to highlight Cleveland's history. On January 1, the sidereal time is 2:17. Now we are going to go 4 hours east and west of the meridian. Notice that a star with a right ascension of 22:17 is west of the meridian, while a star with a right ascension of 6:17 is 4 hours east of the meridian. What this means is that the former star crossed the meridian 4 hours earlier, at 4 p.m., and that the latter star with a right ascension of 6:17 will not cross or transit the meridian for four more hours, or midnight.

Now review the same procedure for June 1. The sidereal time is 12:16, due to the fact that a star with a right ascension of 12:16 is on the meridian. Therefore, by going 4 hours east (we add an hour for each hour east), we find that a star 4 hours east of the meridian at 12:16 sidereal time has a right ascension of 16:16, while a star 4 hours west has a right ascension of 8:16.

4. Now review Table 2, which gives the azimuths and altitudes of stars up to 4 hours east and west of the meridian. The side of the table cites the declinations for various stars from -30° to +84°. The declinations are given for every 6 degrees. From the table, a star with a -30° declination has an azimuth of 180° when it is on the meridian, and has an altitude of 18.5°. One hour before crossing the meridian, it would have an azimuth of 166.5° and an altitude of 17°. Three hours after crossing the meridian, the star would have an azimuth of 218° and an altitude of 7°.

Note: Azimuth and altitude are determined by a star's declination. The hour angles east and west by the star's right ascension.

5. Look at the January monthly star chart. Notice that Aldebaran in the constellation of Taurus the Bull is cited as one of the stars to find to highlight this month's Cleveland history. In fact, starlight left Aldebaran during Cleveland's 1928. Aldebaran has a right ascension of 4 hours and 36 minutes and a declination of +16°, 30 min. Right away, you should note that Aldebaran

is east of the meridian. In fact, if we subtract 2:17, the current sidereal time, from 4:36, the right ascension of Aldebaran, we obtain 2:19 (4:36 - 2:17). Therefore, on January 1, Aldebaran will be on the meridian in 2 hours and 19 minutes, or 10:19 p.m. EST.

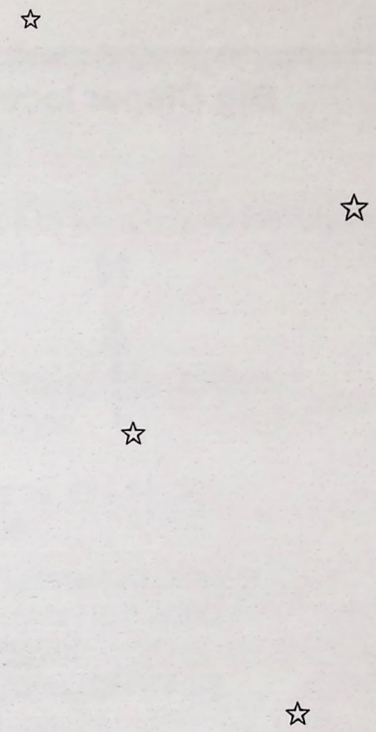
Likewise, we have determined that the hour angle is 2:19. Let's round this number off to 2 hours. By looking at Table 2, we find that there is no listing for a star with a declination of +16°, 30 min., but there is one for a star with a +18° declination. Going across the table at +18° to -2 hours, we find that the azimuth and altitude for this star would be azimuth 123.5° and altitude 55°. Therefore, this measurement will enable us to face near the direction of Aldebaran. The direction would be a little to the south of southeast, and at an altitude of nearly two-thirds the distance to the zenith. The correct location of Aldeberan for the times given is at an azimuth of 120° and an altitude of 51°.

Another example will help to clarify this point. This time, we go outside on April 1 at 9 p.m. to find the star Regulus cited in the April monthly star chart. Notice from Table 3 that the sidereal time for 8 p.m. EST on April 1 is 8:15. We went outside at 9 p.m. EST, which is an hour later. Therefore, the sidereal time on the meridian is 9:15. From the information provided about Regulus, we can see that it is located 87 light years away, and it has a right ascension of 10:08 and a declination of +11°, 59 min. By going through the same procedure as before, we can see that Regulus is to the east of the meridian (10:08 - 9:15 = 53 min.). Therefore, Regulus will be on the meridian in another 53 minutes, or 9:53 p.m. EST. In this case, we will round off the time to an hour angle of one hour east of the meridian. We will assume that Regulus has a declination of 12°. From Table 2, it can be seen that a star with these coordinates would have an azimuth of 155° and an altitude of 58°. Therefore, Regulus at this time would be a little east of due south and an altitude a little more than halfway to the zenith. The accurate location of Regulus for the time cited is azimuth 159° and altitude 59.5°. Our approximation is very close.

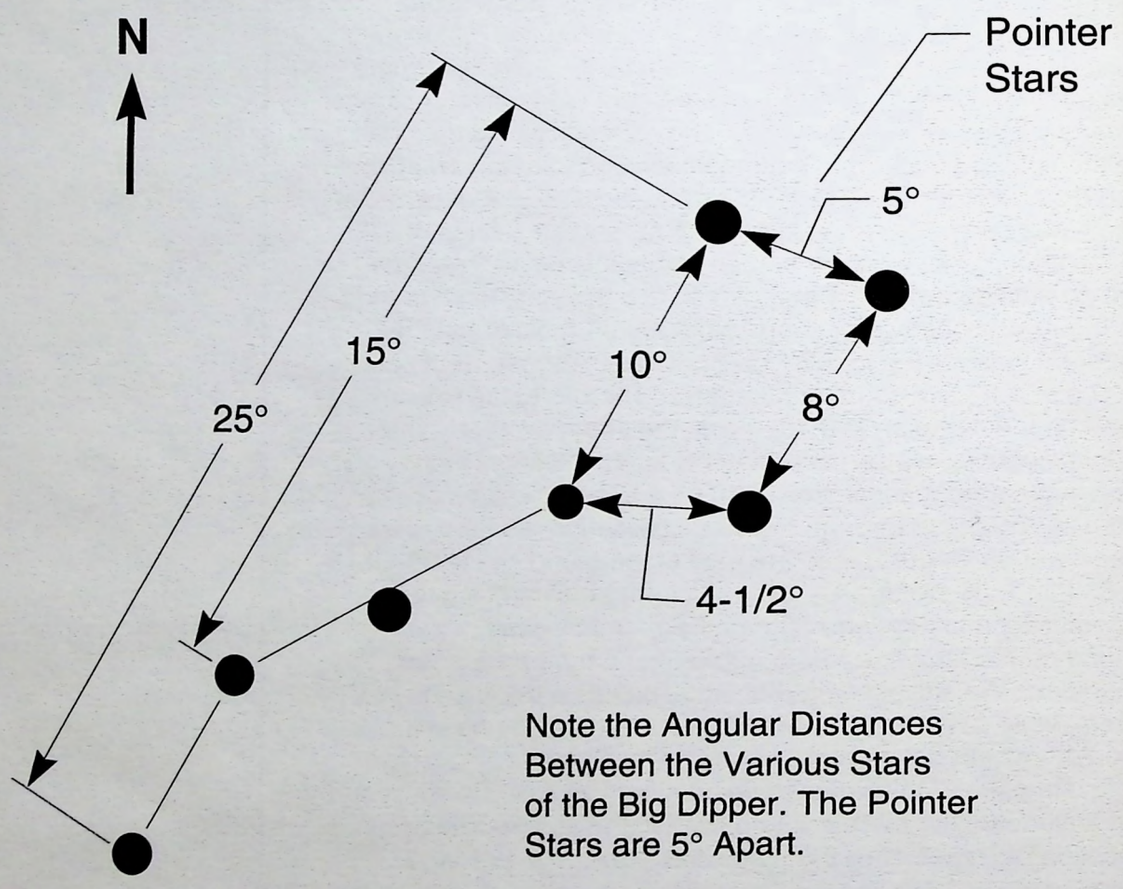
6. Any star chart included in this publication can be used at other times as well. Look at Table 8, which gives the times and dates that any given map can be used throughout the year according to different civil clock times. Take January 1, for example. At 6 p.m., use the December map; 8 p.m., the January map; 10 p.m., the February map; midnight, the March map; 2 a.m., the April map, etc.

The reason for this is the fact that the sidereal time for these dates and times given is 2:17, the same sidereal time as it is at 8 p.m. on January 1.

The only thing that you have to remember is the fact that if you are using a March map in January, the astronomical events cited will only be accurate for March. However, the star locations will be accurate for the time used in January.



Big Dipper location, looking north from E. 9th Street Pier, 8 p.m. EST, January 1, 1996



Local Resources:

Here are a few selected resources that can assist in your understanding of the night sky and Cleveland's history.

Planetariums in the Cleveland area:

You may wish to visit one of the planetariums in the Cleveland area to learn how to identify the constellations and recognize various stars in the night sky. Contact:

School Planetariums:

Dr. Jeanne Bishop, Planetarium Director
Parkside Middle School
24525 Hilliard Road
Westlake, OH 44145
(216) 835-6325

Jim Comienski, Planetarium Director
Lakewood High School
14100 Franklin Avenue
Lakewood, OH 44107
(216) 529-4316

Dan Francetic, Planetarium Director
Euclid Senior High School
711 East 222 Street
Euclid, OH 44123
(216) 261-2900, ext. 362

Ivanell George, Planetarium Director
Strongsville High School
Lunn Road
Strongsville, OH 44136
(216) 572-7100

Gary Norcia, Planetarium Director
Fairview Park High School
4507 West 213 Street
Fairview Park, OH 44126
(216) 346-3500, ext. 22

Vince Ruggiero, Planetarium Director
Mid-Park High School
7000 Paul Dr.
Middleburg Heights, OH 44130
676-8400, ext. 66

Jim Shannon, Planetarium Director
Warrensville Heights High School
4270 Northfield Road
Warrensville Heights, OH 44128
(216) 752-8585, ext. 24

Rod Thompson, Planetarium Director
Mentor High School
6477 Center Street
Mentor, OH 44060
(216) 974-5369

Gene Zajac, Planetarium Director
Shaker Heights High School
15911 Aldersyde Road
Shaker Heights, OH 44129
(216) 295-4251

Public Planetariums:

Joe DeRocher, Planetarium Director
Cleveland Museum of Natural History
Wade Oval Drive, University Circle
Cleveland, OH 44106
(216) 231-4600

Waylena McCully, Director
Schuele Planetarium
Lake Erie Nature and Science Center
28728 Wolf Road
Bay Village, OH 44140

Observatories:

Baldwin Wallace College
Case Western Reserve University
The Cleveland Museum of Natural History

Magazines and Periodicals:

Astronomy Magazine. Published by Kalmbach Publishing, Waukesha, Wisc.

Sky & Telescope Magazine. Published by Sky Publishing Corp., Belmont, Mass.

Mercury Magazine. Published by the Astronomical Society of the Pacific, San Francisco, Calif.

Science and Children Magazine. Published by the National Associations of Science Teachers, Arlington, Va.

Books:

Chartrand, Mark. ***National Audobon Society Field Guide to the Night Sky***. New York: Alfred A. Knopf, 1991.

Chartrand, Mark. ***Skyguide – A Field Guide to the Heavens***. New York: Golden Press, 1990.

Dibbon-Smith, Richard. ***Starlist 2000***. New York: Wiley Science Editions, 1982.

Duffett-Smith, Peter. ***Astronomy with your Personal Computer, 2nd edition***. New York: Cambridge University Press, 1990.

Hirschfeld, Alan, Roger W. Sinnott, and Francois Ochsenbein. ***Sky Catalogue 2000.0 Volume 1: Stars to Magnitude 8.0, 2nd Edition***. New York: Sky Publishing Corporation, 1991.

Reddy, Francis and Greg Walz-Chojnacki. ***Celestial Delights – The Best Astronomical Events through 2001***. Berkeley, Calif.: Celestial Arts, 1992.

Ridpath, Ian, Editor. ***Norton's 2000.0 Star Atlas and Reference Handbook, 18th edition***. New York: John Wiley & Sons, 1990.

Ridpath, Ian and Wil Tirion. ***The Monthly Star Guide, 3rd edition***. New York: Press Syndicate of the University of Cambridge, 1994.

VanAttena, WIlliam F., John Trueh-liang Lee, and E. Dorrit Hoffleit. ***The General Catalogue of Trigonometiric Parallaxes, A Preliminary Version***. New Haven, Conn.: Yale Observatory, 1991.

Internet:

http://www.mtwilson.edu/services/starmap.html

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Van Tassel, David D., and John J. Grabowski, Eds. ***The Encyclopedia of Cleveland History***. Bloomington and Indianapolis: Indiana University Press, 1987.

Vexler, Robert I., Ed. ***Cleveland: A Chronological and Documentary History 1760-1976***. Dobbs Ferry, N.Y.: Oceana Publication, Inc., 1977.

Witchey, Holly Rarick and John Vacha. ***Fine Arts in Cleveland, An Illustrated History***. Bloomington and Indianapolis: Indiana University Press, 1994.

Every effort has been made by the authors to provide factually correct starlight and historical information. However, due to differences between the source materials, occasional discrepancies may occur.

Reflections

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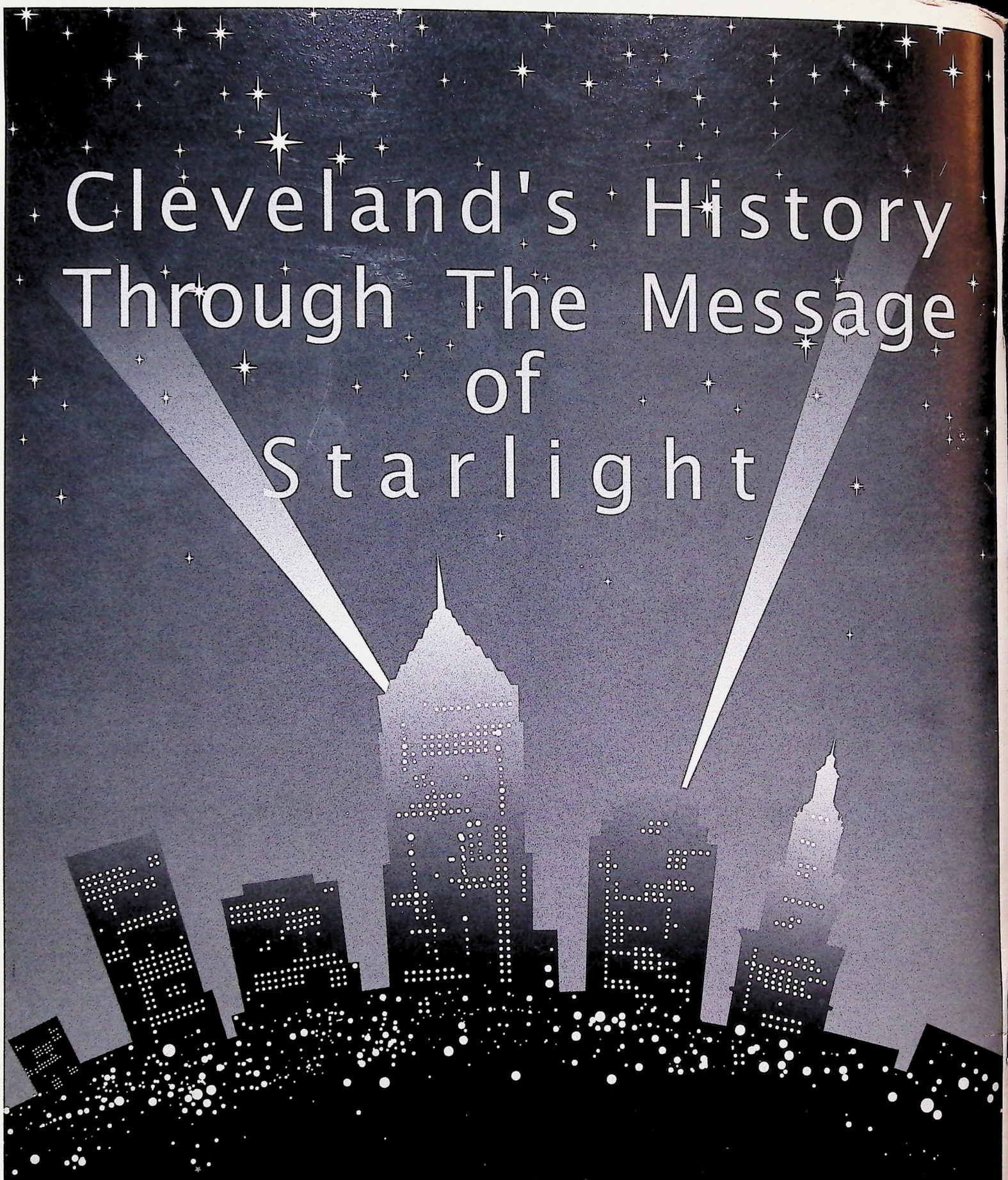
Cleveland's History Through The Message of Starlight



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